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1922—A Bigger, Brighter, and Better Year

At the beginning of a new year, the Contract Record takes the opportunity of wishing its readers much happiness and prosperity. That these conditions will be very conspicuous all over Canada during 1922 is the prediction ventured by the Editor, if he has diagnosed aright the trend of the times. This forecast is based upon an implicit faith in the character of the Canadian people and in their readiness to do whatever is necessary to establish business once again on a firm footing. Admittedly business in some lines during 1921 has not been just as good as may have been desired—various factors have contributed to this—but the new year opens with the promise of at least an average volume of business and bright prospects for a condition much better than average.

Dealing with construction in particular, the Contract Records holds out hope for a very prosperous year. Even during the year past, when high prices were still militating against any pronounced activity, the volume of building was only slightly below that of the previous year, which was the peak since the commencement of war. Details that will appear in the next issue of the Contract Record will show that in 1921 very commendable efforts, indeed, were put forth to stimulate building—efforts that bore fruit in considerable activity.

For 1922, we are confident that building and construction will attain a new high level. Lower material prices and reduced labor costs will exert a stimulating effect. The general public is beginning to feel confidence in values—particularly in those pertaining to building commodities—and it needs only to be reassured that the present figures represent real good value.

Whatever changes may take place during the year will, we believe, be towards a stabilization of prices. Commodities have taken quite a tumble and it is hard to see that they can drop much further until labor eases considerably in price. What retardation there has been in building has been due, in considerable measure, we believe, to the resistance offered by the trades towards the acceptance of lower wages. New agreements will be made this year, however, and from present appearances, it looks as if labor will realize the fallacy of their attitude and be prepared to accept such reductions as will create confidence in the minds of the public. With these new values there is no reason why building should not be very active during 1922.

Begin the New Year Right by Attending the Construction Conference in Hamilton

No better New Year's resolution can be made by any contractor than to attend the Construction Conference to be held in Hamilton on January 17 to 20. However, he should not be content merely with being present at this meeting, but he should resolve to take a keen interest this year in all the activities of his organization—the Association of Canadian Building and Construction Industries—to give it his counsel and advice and in turn absorb the ideas and suggestions proposed by his fellow members. For how can the construction industry of the Dominion attain its rightful place unless it has the co-ordinated backing of every contractor in the country? The A. C. B. C. I., by catering to the needs of the contracting fraternity, is performing an essential work that justifies earnest support from the members, so that the policies advocated by the association may come to fruition.

The conference which the A. C. B. C. I. is holding in Hamilton is one phase of its activities that needs support to ensure its success, but it needs support from the contractors no more than the contractors need the conference. It will be a clearing house at which an exchange and interchange of ideas will develop new thoughts and policies that will improve and stabilize the whole industry. It will be a meeting ground for contractors from all parts of the country, who need to know one another better and who need to appreciate one another's problems and difficulties. The conference in this and other ways can perform a great service. Let contractors recognize its possibilities and be ready to support it by their presence at Hamilton on January 17.

Provincial Builders' and Supply Association to Meet in Peterboro, Ont.

The Provincial Builders' and Supply Association of Ontario have accepted the invitation of Mayor MacIntyre of Peterboro, Ont., to hold their convention in that city on the 21st., 22nd. and 23rd. of February. The members and those connected with the industry can rest assured that the hospitality of that city will well recompense them for their journey.

The questions to come before the convention are

No. 76

Canada's Engineers—Wm. Smaill

Wm. Smaill, chief engineer of the Northern Construction Co., Vancouver, B.C., was born in Montreal in 1870, and received his technical training at McGill University, from which he graduated with the degree B.A. Sc. in 1890. During his vacations, while at college, he acted as assistant to A. P. Low on geological surveys in the Quebec and Lake St. John district. Upon graduation, he joined the Londonderry Iron & Steel Co., in charge of the blast furnace department and coke ovens, remaining with this firm until 1895. Between 1895 and 1900 he was engaged in mining work in different parts of Canada. Since 1900 he has had charge of construction on the following works: Canadian Niagara Power Co., Niagara Falls, Ont.; Great Northern Power Co., Duluth, Minnesota; St. Anthony Falls Power Co., Minneapolis, Minnesota; St. Lawrence River Power Co. and Aluminum Co. of America, Massena, N.Y.; Crescent dam, Mohawk River; New York State barge canal; Mayo concrete bridge across James River, between Richmond and Manchester, Va.; Parr Shoals Power Co., Columbia, S.C.; Champlain Canal; deeping the Hudson River between Stillwater and Mechanicville, N.Y.; Knoxville Power Co., Alcoa, Tenn.; Alderson concrete bridge, Alderson, W. Va. More recently Mr. Smaill has been superintendent and general manager of the Winnipeg Aqueduct Construction Company, Ltd., who built 58 miles of the aqueduct in the Greater Winnipeg Water District. His present position is chief engineer of the Northern Construction Company, Vancouver.

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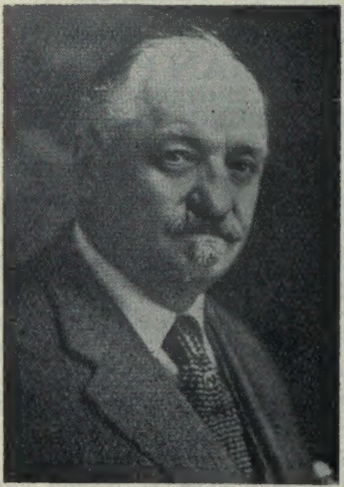


Mr. Wm. Smaill

of direct importance to the industry and are of a Provincial nature, such as; arguments for and against proposed new lien act, compensation act, apprenticeship problems, agreements and wages, building costs today and how to place them before the public, prices of material in various localities, unemployment and its relief, opening of bids in public. These and many other questions affecting the trade will be brought before the meeting.

The meeting will be quite open and discussion will be in the nature of a heart to heart talk on the methods of improving business. There will be no voting or questions that will affect the standing of any member or visitor.

Concrete Institute Meets Feb. 13-16

The American Concrete Institute will hold its annual convention in Cleveland on February 13-16. The program will be spread over nine convention sessions—two sessions a day for three days and three sessions on a fourth day. These will be divided as follows: Two sessions for contractor problems—the practical problems on the job; two sessions for concrete products manufacturers; one session on roads; one session on houses; one session on research; two sessions on engineering design and inspection.

Clay Products Association

The convention of the Canadaian National Clay Products Association, scheduled for February 7 to 9, will be held at the Carls-Rite hotel, Front and Simcoe Streets, Toronto, and not at the Prince George Hotel, as previously announced. The program is in course of preparation, but among the prospective papers is one by W. G. Worcester, who was recently appointed to the chair of ceramics, at the University of Saskatchewan. Mr. Worcester, who is a graduate in ceramics of the Ohio State University, at Columbus, was with the Alberta Clay Products Co., Medicine Hat, and more recently with the Standard Brick Co., of Crawfordville, Ind. He is a member of the C. N. C. P. A. and is eminently suited for the work to which he has been appointed. Another paper of interest is one on pyrometers, by M. B. Hastings, who will show a film prepared by Prof. W. H. Bristol, dealing with them.

Contractors See Gypsum in the Making

On December 20, 1921, the Ontario Gypsum Co., Ltd., of Paris, Ont., entertained several general contractors from Toronto and Hamilton at their Caledonia plant, enlightening them on the processes of mining and manufacturing gypsum. It is the intention of the company to take parties of contractors to their mines and mills whenever the opportunity offers, and in this way acquaint the men who are using their materials with the magnitude of the operations there.

Souvenir of Bridge

In connection with the opening of the Sixteen-Mile Creek bridge on Dundas Road, in Halton County, Ont., (described in the Contract Record of December 21, 1921, p. 1102,) the contractors, Norman McLeod, Ltd., of Toronto, prepared a souvenir folder illustrating the structure and outlining some of its essential features.

Fire losses in Canada during the week ended December 21 are estimated by the Monetary Times at $798,400, compared with $457,500 the previous week.

Farm Drainage in Manitoba Requires Large-Scale Contracting Operations

Specially Designed Excavators of Large Capacity Are Needed to Build Ditches and Flood Control Works — How Drainage Work Is Conducted and Financed

By DOUGLAS L. McLEAN, B. Sc.
Professional Engineer, Manitoba Drainage Commission.

Farm drainage in Manitoba, for the next few years will be the means of providing considerable work for both the lawyer and the contractor. Eventually litigation must result in the undertaking of relief works to protect valuable farm lands from flooding or in the cleaning out of silted up drains, so that the contractor will in any event be the one who finally secures the greater portion of the work necessary to remedy present conditions. The accuracy of this forecast may be appreciated when one considers that the bulk of the drainage work in the province was undertaken 10 to 20 years ago, and that maintenance of the drains has been neglected until today they either must be re-excavated or cleaned out in order to give practical service. In addition there are large areas of farm lands situated on the high lands which carry their drainage waters by artificial means down to the lower lands and dump them there. This gives an added burden of silt and weeds to the lowland drains as well as artificial floods from the surplus waters. Flood control channels are required in these cases. There are also large areas partially and inadequately drained, which will require further drainage to make them fit for cultivation and safe farming. In the government drainage districts alone the area not yet under cultivation is some 1,000,000 acres. Further drain and flood protection works will be needed here. In areas already reclaimed by drainage, maintenance of old drains as well as new works are required to keep these areas from going back to their original swamp conditions.

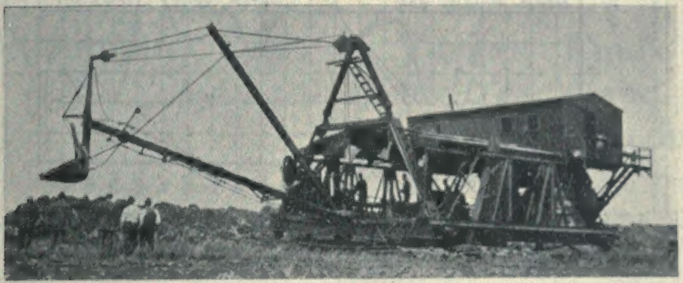


Fig. 1. Walking dredge of the Western Drainage Company at work in Drainage District No. 2. Manitoba

After considering the possibilities of work in the areas already partially served by drains, the undeveloped areas of the provinces might well be examined next as to the possibility of their reclamation. Under present conditions, while there are a number of projects entirely feasible from a construction standpoint, yet from an economic standpoint new projects should not be undertaken until more immigration is available to the province, as a new drainage project requires settlers to make it pay.

Will Drainage Pay

The question, "Will it pay?" applies to every drainage and flood control problem. Under present conditions the best paying type of drainage work is that in areas already included in drainage districts where the soil is fertile, where transportation facilities are available and where development can take place rapidly, if the required drainage is provided.

The question of the interested farmer, "Will it pay?" is of interest only to the contractor to the extent of "who will pay," therefore, an explanation of the present system will be of interest.

The municipalities and the provincial government are the organizations carrying on drainage work. If done by the municipalities, the financing is carried out in accordance with the municipal act. If done by the provincial government, the work comes under the direct charge of the Department of Public Works, through Hon. C. D. McPherson, minister and H. A. Bowman, chief engineer of the reclamation branch. If done in organiged government drainage districts, the government does the engineering, the financing, the awarding of the contracts and the other work necessary in the capital expenditures. The people in the drainage districts pay the bill through yearly levies extending over periods of 20 to 35 years, depending on the life of the bonds floated to finance the work. Thus in 1918, there were 2,029,417 acres of land in organized government drainage districts and the capital expenditure was $3,808,135.00 or an average liability per acre of $1.98 covered by 20 to 35 year bonds.

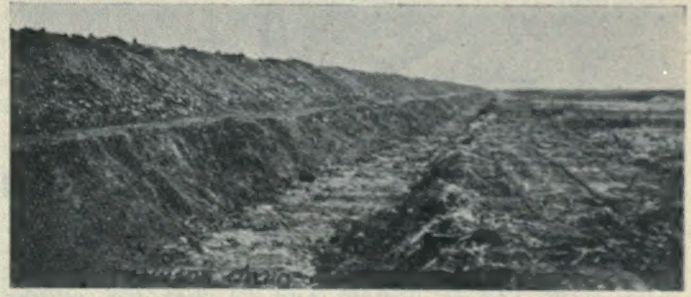


Fig. 2. Drain excavated by walking dredge of Fig. 1. Space not yet levelled into road grade

Where aid is given to a municipality, the municipality agrees to pay a portion of the cost of the work and the Minister of Public Works, on recommendation of his chief engineer, H. A. Bowman agrees to pay the balance. Such aid is absolutely necessary in the newer portions of the province where the Dominion government holds lands, which as Dominion lands, cannot be taxed for drains or other works essential to the opening up of these new areas. This expense is one of the indirect burdens imposed upon the province by the retention of Manitoba's natural resources by the Dominion government, and is also the means of retarding necessary works in many areas.

Obstacles to Drainage Development

Other obstacles which have prevented adequate drainage, in the organized drainage districts in particular, and have contributed to the holding back of the development of fertile areas may be listed as follows:—Control, past and present, of Manitoba's natural resources by the Dominion government, land speculation, the flat assessment for drainage benefits resulting in unfair and unjust taxation, the floodings from the high lands outside drainage districts, no maintenance or practical means of providing for maintenance of the drains, and unworkable drainage laws. To secure solutions to these troubles accumulated from past adminstrations and from the natural growth of the country, the Provincial government appointed a drainage commission consisting of chairman J. G, Sullivan, consulting engineer, and commissioners J. A. Thompson and H. Grills, to investigate and report on these matters.

It was soon found that the most urgent matter requiring attention was the securing of relief from inadequate drainage. Work for this purpose was undertaken and during the last two years a number of relief drains have been constructed in drainage districts No. 2 and 12 by the Department of Public Works, under the direction of H. A. Bowman, chief engineer of the reclamation branch.

Walking Dredge For Excavation Work

Photograph No. 1 shows a walking dredge constructed by the Carter-Halls-Aldinger Co., contractors, and used by the Western Drainage Company on drainage work in Northern Minnesota and Manitoba, where a machine capable of operating on dry land as well as through swamps was required. It is equipped with four pads 6 feet by 8 feet for supporting it in peat areas. The centre to centre span is 31 feet 9 inches. These machines can excavate drains 6 feet deep, with 12 feet bottom and 24 feet top widths and place the spoil 36 feet from the centre line, leaving a clear berm of 10 feet along the edge of the drain. By putting the material on both sides of the excavation they can leave a wider berm for such size of drain as that given. The dipper bucket used is 4½ feet wide by 6 feet long. The power is supplied by a gasoline engine rated at 75 h. p. using 150 to 175 gallons per 24 hrs. This machine will handle up to 1300 cubic yards per 24 hours in good digging. The operating crew is usually divided into two gangs who work in alternate shifts each gang taking two hour shifts during a 24 hour day. In addition there is a cook. Living quarters are provided in the caboose shown on the roof of the machine. Photograph No. 2 shows a drain excavated by one of these machines before the spoil bank has been levelled to form a road grade.

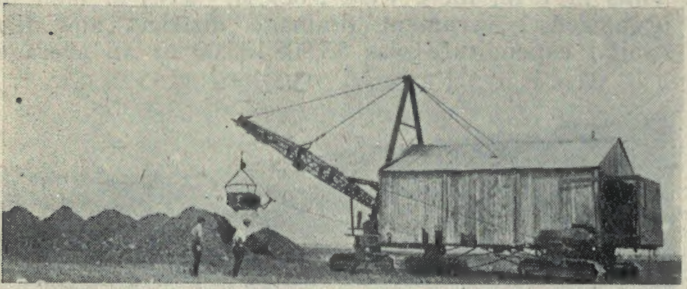


Fig. 3. Dragline Dredge at work in Drainage District No. 12, Manitoba

Another type of machine used extensively in constructing drainage works is the drag-line. Photograph No. 3 shows one of these machines owned by the Lount Engineering Co., working on a drain in drainage district No. 12. This machine is one of the swing-boom type and instead of the whole machine rotating, the boom alone moves from side to side. The boom cannot be raised or lowered except by lengthening the fixed guy cable. This machine has a rated capacity of 30,000 cubic yards per month. It weighs 30 tons, has a one cubic yard Paige automatic bucket, 50 feet boom, 50 h.p. kerosene engine, 3 feet 8 inch caterpillars, a speed, walking light, of 5 miles per hour. It can be dismounted in two days for loading on freight cars, and can be erected in three days.

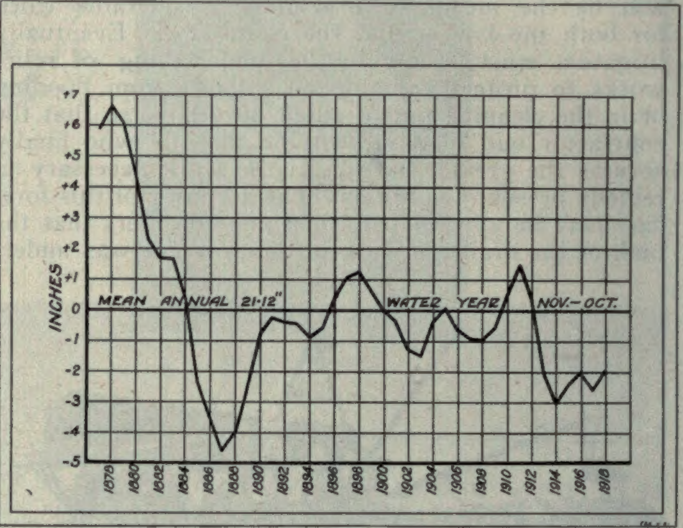


Fig. 4. Diagram showing progressive mean annual precipitation at Winnipeg, 1878-1918

Amount of Excavation

The quantities of excavation handled varies with the material, the size of the drain and the season. Some average figures from the Greater Winnipeg water supply project work shown in Table are those

TABLE No. I.

A few records of earth excavation from the trench with various classes of machinery engaged.

Type of machine and capacity	Average depth of cut	Average ydg. exca'ted per 10-hr. day	Material Excavated
Marion shovel, 1½ c.y. dipper.	12′-0″	612 c.y.	Clay
Walking dredge, 1 c.y. dipper	8′-0″	745 c.y.	Clay
Buryrus dragline, 1 c.y. bucket...	6′-0″	640 c.y.	3 ft. peat, 3 ft. sandy clay
Buryrus dragline, 1 c.y. bucket...	7′-5″	740 c.y.	1 ft. top soil, 6 ft. 5 in. fine sand (wet)
Buryrus dragline, 1 c.y. bucket...	9′-0″	900 c.y.	2 ft. peat, 3 ft. fine sand, 4 ft. sand and gravel
Buryrus dragline, 2 c.y. bucket...	14′-0″	1950 c.y.	12 ft. peat, 2 ft. clay in bottom of trench
Buryrus dragline, 3½ c.y. bucket.	18′-5″	2920 c.y.	6 ft. peat, 12 ft. 5 in. clay

that can be obtained on drains under similar conditions.

There are certain large projects under consideration at the present time in drainage districts No. 1 and No. 2, and what will be done on them will to a large extent depend on those interested.

In drainage district No. 2, the toll from rust makes drainage essential to large areas. Another factor which does not appear, but which is nevertheless an important one, is the fact that since 1912, this area has been going through a cycle of dry years, as shown on rainfall plate 4, and following this dry period one must look for a period of wet years. Such a period would put a severe tax on the drains, not only in this district but in those in other areas.

Drainage Works to Save Farms

With a cycle of wet years, it would be a question whether the crop areas, reclaimed from swamp lands and constituting over one seventh of the crop area of the province would be allowed to return to swamp conditions or whether these areas would be given the drainage necessary to protect them and ensure safe farming.

With rust, floods, an approaching cycle of wet years, and inefficient laws, the farmer in large fertile reclaimed areas is up against a hard proposition. In many cases ruin will result to him if not given proper protection. These difficulties of the farmer are to the advantage of the contractor, for to meet them the only practical solution is the installation of adequate drainage and flood control works.

In large areas of the province such drainage works would not only give the farmer the best return on his money of any expenditure he could make, but would also be of benefit to the whole province in adding wealth producing areas to its agricultural lands and would prevent an enormous economic waste, which now takes place from inadequate drainage and yearly floodings.

Compressed Air in the Maintenance of Bridges and Buildings

Pneumatic Tools of Various Kinds Are Widely Used by the Railway Companies for Track and Structure Upkeep — Labor Requirements Reduced to a Minimum

By F. A. McLEAN
Canadian Ingersoll Rand Co., Ltd., Sherbrooke, P.Q.

Almost from the inception of the application of compressed air as a means of power transmission, the railroads have been among the largest users of air operated appliances of various kinds, in locomotive and car shops, signal systems, etc. This is perhaps not at all strange when one stops to consider what an important part the air brake has played in the development and operation of modern high speed railroad equipment.

About five years ago the pneumatic tie-tamper was introduced and although it met with considerable opposition, it has been adopted as standard equipment by practically all the largest steam roads in the United States, as well as on many city and interurban electric lines. In Canada it has made somewhat slower progress, due perhaps to the fact that cheap labor was more readily obtainable than in the United States, and to the natural reluctance of most of us to use anything with which we are not familiar, or which we are inclined to think is still in an experimental stage. A few of these machines are at present in use on large Canadian steam and electric roads and in view of the report of the Committee on Labor Saving Devices presented at the thirty-sixth annual convention of the Roadmasters and Maintenance of Way Association of America, at Chicago, Ill., September, 17-19, 1918, that in their opinion no tool in recent years furnished to track forces had made its appearance at a more opportune time, or filled in a greater void than the air operated tie-tamper, it seems entirely reasonable to expect that within a few years as maintenance-of-way officials become better acquainted with their merits, these tools will be as extensively used on the steam and electric lines of this country as they are in the States.

Labour is generally conceded to be the largest single item entering into maintenance-of-way and structure expense, sometimes being as much as or more than all other items combined, averaging from 50 to 55% of the tool, and the saving in this respect which the use of pneumatic tie-tamping outfits has made possible in the operation of laying new track, replacing old track, or re-surfacing track which is already in existence, has caused some of the more progressive bridge and building masters to devise means by which compressed air could be applied to their particular branch of railway maintenance and construction work.

Portable Outfits for Track Work

A number of roads have fitted up old box cars as portable compressed air power plants of sufficient size to operate a number of tie-tampers, or other air tools, by the installation of steam, gasoline, or electric-driven, straight line compressors with water tanks and air receivers of proper capacity. An outfit of this kind is easily rigged up and is very useful, but has one or two drawbacks which limit its field to some extent, in that it cannot be readily moved from one section to another without the use of a locomotive, and due to its weight and bulk, it cannot be removed from the rails, and is thus only available for use where traffic is light or where a convenient siding is at hand. Mounting the compressor on an automatic chassis or horse-drawn vehicle gives a little more lee-way in this respect in the case of electric roads, but is not of much use on steam roads, as the road bed is seldom wide enough to allow the use of a vehicle of this type and the roads or highways are often some distance away from the railroad tracks.

Some roads use one or more air brake compressors operated by steam from an old locomotive, a steam shovel, a crane car or a boiler mounted on a flat car with more or less success. Where the necessary materials are at hand the ease and cheapness with which outfits of this kind can be rigged up make them worthy of consideration. Equipment of this kind is as a rule, however, rather bulky for its output and the efficiency of the direct acting air brake compressor cannot be compared with the more advanced steam, gasoline or electric types.

One type of equipment, simple, compact, and self-contained, which not only provides a convenient and efficient source of power for the operation of pneumatic tampers in the hands of the track forces but enables bridge and building departments to make use of compressed air to the widest extent is now being built by the Ingersoll-Rand Co. under the trade name of the Imperial bridge repair outfit. The power plant consists of a direct connected gasoline or electric-driven vertical compressor, of sufficient size to supply four air lines, mounted on a machined sub-base which is in turn attached to a heavily constructed vehicle of the push car type.

For the use of steam roads, or electric roads which prefer a self-propelled outfit, an engine of the two cycle type, fitted with an automatic governor is provided. An automatic pressure operated unloading device placed between the discharge line and the air receiver keeps the pressure in the latter within the desired limits. The engine-driven car is self-propelled by means of a sprocket and chain which can be thrown in or out of gear by a clutch connection with the main shaft. The car has sufficient power to haul twelve men in addition to the tools and accessories supplied with the outfit, at a speed of 12 to 15 miles per hour, and will readily climb a 4% grade when fully loaded. The brakes are operated by the foot and have a holding power considerably in excess of what would be required under ordinary conditions, so as to provide an ample factor of safety should the engine suddenly stop while the car was climbing a grade from some accidental cause.

The motor-driven outfits are provided with a draw-bar socket for coupling to a street car or electric locomotive, and both outfits are equipped with cross trucks or wheels for quickly removing the car to and from the track. A removable sheet steel housing protects the working parts from the elements when it is necessary to leave the car out of doors for any length of time, and may be locked to prevent tampering if desired.

Each car is ordinarily fitted up with a pneumatic drill with sufficient power to ream and tap up to one inch drive a 1-¼" twist drill, a riveting hammer or gun with 3/4" and 1" rivet sets, a set clip, and a rivet buster chisel, also unique sand blast and paint spray nozzles, of simple design. The drill is useful for drilling and reaming holes in structural members of bridges and buildings, boring holes in ties, running down screw spikes and lag screws, tightening bolts, drilling and reaming holes in rails for bonding or joining, etc., while the hammer is applied to such jobs as driving or "busting" rivets and chipping metal, in steel culvert, bridge, cattle guard, or similar work.

Sand Blast and Paint Spray

Although the application of pneumatic drills and hammers to bridge and repair work is by no means new, the use of the sand blast and paint spray for this work is, however, a decided innovation on many roads. The advantages, accruing from the use of these devices are readily apparent. With the sand blast it is possible to clean off rust and scale more quickly and thoroughly than would be possible by any other method. This is especially true in the case of sharp corners, pockets, lattice work, etc., the cleaning of which by hand, is a very tedious and costly job. The sand blast, is of a very simple type, does not repuire tanks or special equipment, is easily operated, and has been found economical in the use of sand, which may be of any variety so long as it does not contain gravel, or pebbles. Wherever it is possible to do so, it is a good plan to arrange a piece of tarpaulin in such a way as to catch the sand, which may then be used over again several times. The sand

Drilling joint holes in the web of rails with a portable pneumatic close corner drill and a quick action clamping attachment or "old man"

Boring spike holes in ties with pneumatic wood borer

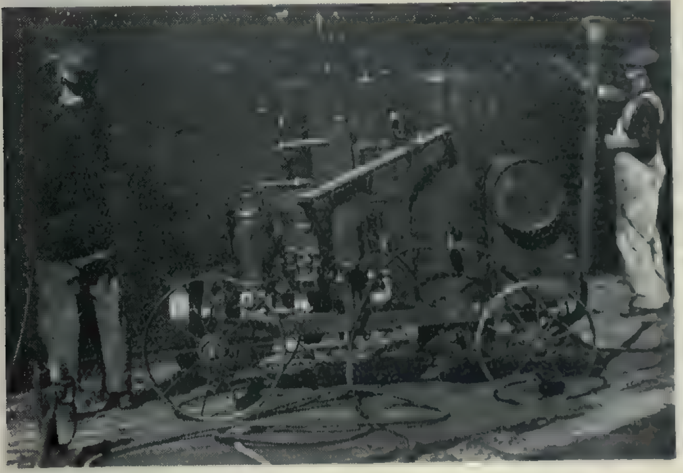
Grinder at work on switch points

may be taken from a pit, a pail, or even a loose pile, as may be convenient in each case. The weight of the attachment is about eight pounds and it is adapted to a wide range of work on stone, concrete, brick or steel.

The paint spraying device which weighs approximately two pounds applies a solid uniform coating of paint, whitewash, creosote, or any other liquid of as great a thickness as may be desired, in one operation. This does away with the necessity of applying three or four coats by hand and results in a saving of about 90 per cent in time. The density of the spray is subject to accurate control, the nozzle being adjustable for a light or heavy coat with various grades of paint which can be drawn from any type of container, the most common way being to take it from a can placed on the scaffold near the painter. With the paint spray in use it is not necessary to stir the paint as the action of the air keeps it thoroughly mixed, assuring a coating of uniform quality at all times.

Chipping Hammer

A handy addition to an outfit of this kind is a light chipping hammer or two which may be used for dressing up concrete and masonry, scaling paint and rust from badly corroded iron and steel surfaces, etc. The makers of the compressor cars referred to herein have recently brought out a simple attachment whereby their chipping hammers may be used as plug drills in which capacity they will drill holes in stone concrete or brick up to 3/4" in diameter and 8 or 9 inches in depth. With this arrangement the utility of the tool is increased and the necessity of carrying two separate tools is done away with. Plug drills are adapted to such work as drilling holes in concrete or stone piers, doorways, window sills, etc., previous to the attachment of buffer plates; anchor bolt holes for girders, guy wires and machinery; holes in walls, floors and foundations of buildings for conduit, steam, air water or gas pipes; breaking up blocks of stone by the plug and feather method, etc.



Gasoline engine driven portable compressor supplying air to pneumatic paint sprayer

The rock drilling requirements of many construction and maintenance jobs are beyond the range of plug drills and where this is the the case a light hand hammer drill of the Jackhamer type will be found more effective. These drills are obtainable in four sizes weighing from 21-½ to 70 pounds and will drill 6, 8, 12 and 20 foot holes according to size. The larger size may be used with or without a mounting and with solid steel or with hollow steel and water feed to wash cuttings from the hole as desired.

Pneumatic Grinder

A pneumatic grinder is often of value for grinding switch points, ends of rails that are to be bonded and other odd jobs that are usually done with a file or rasp. When equipped with a stiff wirebrush these tools are useful for cleaning stone, concrete and brick walls, removing rust and old paint, cleaning concrete reinforcing bars before use, etc. Closely allied to the grinder is the pneumatic saw which may be used for cutting off timbers, cutting slots in flooring, grooving for strap irons, mitering, cutting off the projecting ends of boards used in the construction of platforms, fences, sheds, box cars, etc., and many other odd jobs.

In the erection of heavy wooden structures pneumatic spike drivers or drift bolt drivers as they are sometimes called, have met with considerable success for such work as driving heavy bolts, spikes, tree nails, tie rods, etc.

Air hoists of the direct lift type mounted on flat cars are often used for special work such as handling rails, ties, piles, logs and heavy timber of various kinds. With a good portable compressor outfit it is possible to go a step or two farther in this direction and carry a small direct lift hoist or preferably one of the small motor driven hoists as they may be used for a larger variety of work.

These hoists are readily carried about, may be set up almost anywhere within a few minutes without the use of special tools or fittings and are adapted for such jobs as hoisting stone, cement, brick, mortar, timber or structural steel, hauling boxes, bales and drag scrapers, skidding logs, pulling rails through benders, erecting machinery, spotting and switching cars and other light hauling, hoisting, and handling work.

Rammers for Tamping Purposes

For ramming concrete, tamping earth around culverts, retaining walls, pipes, etc., pneumatic rammers may be carried in an outfit of this kind and have the advantage of much greater speed and uniformity in results than can be obtained by hand operated rammers or tamping bars. Pumps, jacks, concrete mixers, etc., may be driven with power supplied by the car and the tampers usually used for tamping ballast may be applied to such work as adzing ties, breaking out frozen coal or frozen dirt and other debris from cattle cars, tearing up concrete or asphalt pavement, in making repairs to switches or sidings running through city streets and the like when necessary.

Through the use of pneumatic tools and appliances five or six men can efficiently perform all of the odd jobs incident to the maintenance of bridges, buildings, etc., with a minimum amount of time and trouble. As an example of what may be done through the use of equipment of this kind it is interesting to note that the N. Y. C. and H. R. R. operating four pneumatic drills fitted with a special quick acting clamping feeing attachment, by one of these cars described herein drills 9/32" holes in 100 pound rail at the rate of 70 holes per minute not counting the delays due to traffic and moving of the drills each of which are operated and shifted by one man. On the C. M. & St. P. R. R. 1000 7/8" holes were drilled in the web of 85 pound rail in a day, all delays for traffic and moving included. This was done by four men operating two close corner drills fitted with a special feeding and clamping attachment, similar to that shown in one of the illustrations herewith.

The compressor cars described herein weigh approximately 3300 pounds and in removing them from the track each side of the car is raised two or three inches in turn, allowing temporary rails formed of two by four inch scantlings to be placed under the cross trucks or derailing wheels at each end of the car. These small wheels have double flanges, and have their tread about two inches higher than that of the main wheels. Four men can lift the car with ease upon these simple cross rails and roll it onto a stand formed by driving short posts into the ground and cutting them off at the desired level, or on to a crib prepared by laying ties on the ground or shoulder of the roadbed at the point where it is desired to move the car from the track. The actual time required for four men to remove or replace the car on the track, once the stand or crib is built is about forty-five seconds.

Labor Force Reduced

Through the use of self-propelled, air operated, bridge repair equipment it is possible to greatly reduce the size of the repair gangs required, which is an important factor when the scarcity and high cost of labor and often the low efficiency of that which is obtainable is taken into consideration. Reducing the size of the gangs, avoids the tying up of locomotives and cars for work train service and the men are often carried to their work, the job finished, and the men back again before the materials for performing the work by hand could be loaded on cars, switched into a way freight or work train, and transported to their destination ready for use. One of the large eastern roads among the first to adopt equipment of this type found that through its use they could reduce their labor turnover to a large extent as the strain on the men was considerably less than when hand operated equipment was used exclusively, and the fact that the outfits were self-propelling made it possible for the men to live at some distance from their work in order to take advantage of lower living expenses, and still be on hand ready to start work at seven o'clock in the morning. The company built a section house convenient to the men's homes where they assembled a few minutes before seven each morning, started the car and arrived at the scene of their labors in a few minutes and were back again in good time at night.

Gasoline Revolving Shovel

New Machine Makes Its Appearance—Declared to Be as Flexible as Steam Equipment

A gasoline operated shovel with no engines, motors, shafts, chains or gears on the boom and yet with an actual digging power greater than a steam shovel of the same size, is the most recent innovation in the manufacture of excavating machinery. Such a shovel has recently been announced by the Bucyrus Company of South Milwaukee, Wisconsin.

This machine, which is known as their 30-B gasoline shovel, marks a distinct advance in the design of excavating machinery. For more than ten years Bucyrus dragline excavators have been operated by gasoline engines, but the application of this power to the revolving shovel involved more difficult and intricate problems, chief among these being the efficient transmission of power to the thrust without excessive complications in design, and the obtaining of digging power commensurate with that of a steam machine of similar size.

Both of these problems have been satisfactorily solved in this new shovel. Furthermore, the manufacturers have succeeded in obtaining in this new machine the digging characteristics of the steam shovel with its quick reversals, its powerful thrust of the dipper and its dependability.

Before being put on the market, this shovel was used for a period of six months for overcasting and loading dump cars in sticky clay, for grading for a concrete road where the cut averaged five inches in old macadam, and for stripping a stone quarry and loading trucks in a stiff hardpan containing many boulders.

Its unqualified success, therefore, has been completely demonstrated by actual test in the field.

The outstanding features of this shovel may be summarized as follows:

It is far simpler than a steam, electric or other types of gasoline shovels and has fewer parts to maintain and keep in order.

A new type of gasoline driven shovel

Its digging power is even greater than a steam shovel of the same size.

It has all the well known performance characteristics of a steam shovel, even to the shaking of the dipper to relieve it of sticky material.

It will give 20 per cent greater yardage per gallon of gasoline than an electric shovel of the same size, or than any other type of shovel whose power is derived from a gasoline engine. This is due to less mechanical losses and less waste energy.

The gasoline engine with which this shovel is equipped is over twice as heavy and rugged as the type of commercial gasoline engine sold for this purpose. It was designed especially for this shovel from specifications offered by the Bucyrus engineers and consequently it is suited for the exacting requirements of this unusually severe service.

It is entirely enclosed and thus dust proof, a feature of much importance for excavating work.

The engine is a four cylinder, slow speed type and will develop 55 h.p. at a speed of 400 r.p.m.

The shovel carries a 1-yard dipper.

This machine may be equipped as a dragline excavator, a crane or a clamshell machine with simple changes which may be made in the field.

Special Chart Records Progress of Track Reconstruction in Toronto

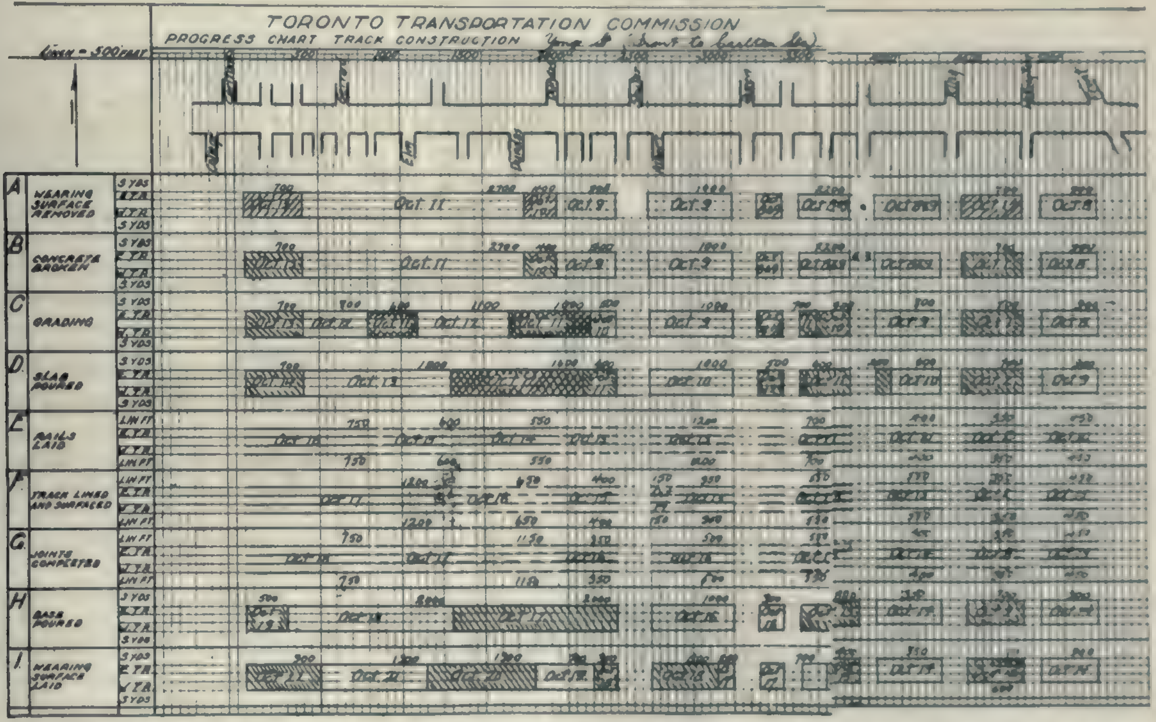
In the article descriptive of the track reconstruction operations of the Toronto Transportation Commission, in the Contract Record of November 23, 1921, emphasis was laid on the speed with which the work was carried out. Owing to the urgent necessity of putting the tracks in good order and on account of the short working period prior to winter, the task of rehabilitation was speeded up and with a splendidly organized and equipped working force, record breaking achievements were accomplished. No better way of visualizing the efforts of the Commission, aside from actual observation of the work in progress, is afforded than by a study of the progress charts which were prepared for record purposes and to keep the Commission and its executives advised of the exact state of the reconstruction at any particular time. A sample progress chart is reproduced herewith to indicate its significance and to show how it was prepared.

The charts are plotted on paper especially squared to suit the nature of the facts recorded thereon. They are divided into nine sections, each representing one of the various operations in track reconstruction, viz. —wearing surface removed, concrete broken, grading, slab poured, rails laid, track lined and surfaced, joints completed, base poured, wearing surface laid. Horizontal lines in each section represents the two pairs of rails with the devil strip between. The vertical lines divide the chart into spaces each of which represents 50 lineal feet of track. At the top, space is reserved for an outline map of the street undergoing reconstruction, which is drawn to the same scale.

Each element in the rehabilitation scheme is plotted as the work progresses, different colors being used to differentiate each day's work. There is thus presented a graphic representation of the situation along the route at the end of any particular day and comparisons are readily made between the outputs on any desired occasions. In reproducing the sample chart, we have necessarily had to omit colors, and employ various hatchings instead. The dates are written on the squares affected, as are also the number of square yards or lineal feet finished.

To illustrate the working of the chart and to show the speed of the operations, take the section of Yonge St. between Wellington St. and King St. It will be observed that on this section, about 375 feet long, the wearing surface was removed, concrete broken, and grading completed on October 1. The next day the slab was poured, the rails laid and the track lined and surfaced. On October 8 the joints were completed, while the base was poured the following day. The track was entirely completed by the laying of the wearing surface on October 12. A similar analysis may be made for any section of the street and in some cases the speed was even greater than on the section selected above. For example, the portion from Front to Wellington Sts. was finished between October 8 and 14. A study of the progress made in each individual operation also gives an interesting insight into the rapidity and efficiency with which the Toronto Transportation Commission's organization worked.

Similar charts were prepared for every piece of reconstruction undertaken, affording a condensed but accurate view of the whole situation—a necessity in view of the scale upon which the work was carried out.



Progress chart used by the Toronto Transportation Commission. (The original was on two sheets which were on slightly different scales; consequently in the reproduction above the two sections of the chart do not exactly match)

Uniform Construction Contracts

Recent Conference Formulates Plans to Standardize Documents Relating to Contracting—Investigation Discloses Over 200 Forms in Common Use

The standardization of construction contracts towards which all far-sighted men in the industry have been looking for the last twenty years seems destined to be achieved at last through the united efforts of a "conference" held in Washington, D. C. recently.

This conference was composed of delegates appointed by eight national societies representing engineers, architects and contractors, and the definite plan adopted was one which would ultimately produce a standard form of contract "agreement" which would be acceptable in all sections of the country and in all phases of this huge industry which now ranks second only to agriculture in magnitude.

Every constructor and owner who has wrestled with the intricacies of a contract, or worried over the exact yet doubtful meaning of its many complicated and legalized phrases, will approve this first attempt to frame in simple Anglo-Saxon words an equitable and universal document.

A survey of the situation made several months ago by Brigadier-general R. C. Marshall, jr., manager of the Associated General Contractors, disclosed the fact that to-day there are in common use throughout the construction industry, over 200 different forms of contract, and that no one state or section had yet been able to establish any one form as standard or customary.

Expert engineers at the headquarters of the Associated General Contractors of America in Washington, were then assigned to the task of analyzing these 200 different forms in order to discover whether the variety of "jobs" involved required any such variety of forms.

One Standard Contract Form

After many months of painstaking comparison and research, W. P. Christie, in charge of this work as research engineer for the Associated General Contractors reported that the differences were chiefly superficial differences of words and phrasing rather than differences of meaning or stipulations, and that at least two-thirds of all the provisions contained in each of the 200 documents were common to all documents, and therefore could be included in one standard contract form, if rewritten in simple universal style.

It was found that stipulations which were characteristic or peculiar to the building trades, or to the railroad construction field, or to waterworks projects, or to highways, could be assembled together in one standard form, entitled "general conditions", applicable to that one field of construction only, and added to the standard agreement form as addenda.

In this way, it would be quite possible to draft a standard contract which would cover all cases of construction work, no matter in what field, and the only alteration that would ever need to be made to it, would be in selecting the standard form of "General Conditions" which covered the type of job concerned. Experts believed that a half dozen such forms would cover the main subdivisions involved in the construction industry.

This plan together with a "tentative outline" was submitted for consideration to the American Association of State Highway Officials, American Engineering Council, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Waterworks Association, Associated General Contractors of America, National Association of Builders Exchanges, Western Society of Engineers.

All made favorable responses and appointed representatives to come to Washington to constitute a conference on the subject and proceed with the drafting of a tentative form of contract which could later be officially submitted by the conference to its constituting bodies for criticism, amendments, and ultimate ratification.

The conference met in Washington on December 15 and 16, and was addressed by U. S. Secretary of Commerce Hoover and General Marshall, both of whom expressed a very lively and sincere hope that the conference would ultimately devise a form which would become as standard in its field as the standard forms of bank checks, notes and mortgages are in the field of banking and commercial trade.

Great Field for Improvement

Secretary of Commerce Hoover, said, in opening the conference:

"Well, gentlemen, this conference is to consider whether something can be done to standardize or simplify or reinforce or generally improve the whole basis of contract forms used in the construction industry.

"I believe there is a great field there not only in protection to the public but in the general improvement of ethics in the industry itself. I don't profess to know much about it, but it is a matter that has not come under my purview for some years. I have been too much out of the engineering work for the last seven years to give much thought to it.

"I know that the time I was in engineering work this whole variation and specification of the contract basis for construction work of all kinds was an outstanding sore, and I have been in hopes that it was possible to do something. It all comes in line with the things many of us are much concerned with, and that is fundamentally the elimination of waste, lost motion and improvement of business practices.

"We have to remember that we have now an enlarged and inflated cost of distribution primarily, rather than production, and that we have a disparity due to the fundamentals of the increase in Federal taxation and railway rates that are making a wider margin between production and final distribution costs than we have ever had to face before, and unless we can crowd that margin down somewhat by just sheer increase in efficiency, we are not going to be able to hold up the standard of living in this country and hold up our competitive position outside. So this is one of those things that ramify in many directions.

"I now therefore leave it to you, and we are glad to have you come to this Department, because we have started a definite program along all these lines, not from a point of view of trying to compel anybody to do anything, but trying to mobilize all the different branches of industry for co-operative action, and while you can do much to get this thing straightened out it is probable that the Department of Commerce could be of moral assistance to you in getting it over when you have once arrived at some conclusions, and we will be delighted to back up anything you may come to an agreement on, and I have been astonished at the desire of the different industries to effect these things in every direction and their willingness to co-operate with other industries to make the work of each individual industry effective.

"We had the case the other day of the simplification of certain manufactured articles. The great majority of the manufacturers were represented here, but claimed that some minority would not help. They could not do anything without the assistance of other branches, and therefore, I called in both the wholesalers and retailers in those directions and asked them if they would co-operate, and they have co-operated so far as to almost set up a boycott against certain manufacturers because they would not fall into line with the great majority, and they did it purely out of national interest.

"Somebody somewhere has got to eliminate the waste in this whole situation. I only mention that as a point where this Department can be of help in getting the allegiance of the related industries and trades, and help you to get over some program of this kind."

Advantages of Uniform Contracts

The aim of the conference in beginning work on this difficult task was to achieve the following advantages for the entire construction industry and all its affiliations:

(1) Less expenditure and legal service.

(2) Less duplication of work in the professions.

(3) Elimination of disputes.

(4) Better safeguard for owners and increased public confidence.

(5) An improved standard of construction service throughout the country.

A course of procedure devised by General Marshall for the study and development of standard forms was unanimously adopted as the method of handling the job. A memorandum covering this scheme was printed in the last issue of the Contract Record.

References were made to similar efforts which had been made by the American Engineering Standards Committee in setting standards for materials and methods of construction; also to work by the Engineering Council in drawing up standards for government contract work; and to the effort of the American Railway Engineering Association along the same line in their special field.

William S. Parker of Boston, Mass., secretary of the American Institute of Architects, narrated the interesting experiences of their committees during the last twenty years in the attempt to promulgate a standard form of contract which would be universally accepted by architects and builders.

He said: "Our work started back in the very early 1900's and a committee worked for five or six years on what was eventually called the first edition of the American Institute Standard Documents. That document was not put into general use because it was badly planned in its physical arrangement and printed in type not easily read and was developed by architects with the view of protecting the interests of the owner only.

"In 1912 we realized that it wasn't accomplishing its purpose or justifying the time and expense put into it and took up a plan for revision under the chairmanship of Frank Miles Day of Philadelphia.

"Later we called a meeting of contractors, subcontractors and architects and legal representatives of both sides, in Philadelphia, and both sides had their say as the document developed. That was completed and the second edition printed in 1914, but the Building Trades Employers' Association in New York took exception to a few points, so we called a further conference in 1916 and issued our third edition in 1917. This edition is selling at the rate of 50,000 copies annually, and our Board of Directors has decided that we will not make any further changes for some years to come."

Standardization in Road Work

Mr. H. K. Bishop speaking for the highway men, described how the U. S. Bureau of Public Roads had enforced the standardization of contract forms, also the bond, proposal, specification and plans forms which were used on highway construction that involved federal aid.

He said: "In general we used the short form of contract covering only one or two pages, making all the specifications, which carry all of the standard clauses, a part of the contract. Even the sheets were of standard size and typography, and we went so far as to standardize the structures. Now you will find if you pick up specifications in one state you can't tell what state it is until you look to see on the title page. And we find that the counties are gradually following the states so that this standardization is extended not only to the forty-eight states of the Union but to most of their sub-divisions. We have found that very much simplifies the work."

Mr. W. D. Faucette of Norfolk, Va., chief engineer of the Seaboard Airline Railway, speaking of his experience as chairman of the committee on reform of general contract forms, described the "uniform general contract form" which the Association of Railway Engineering had adopted at its convention in 1913 and printed in its manual. After stating that it was not obligatory upon the membership of his association to use it but that it was generally considered a "guide-post" for engineers with railroad contracts to let, he said: "I sent out seventy-five letters to the principal railroads of the United States and Canada to ascertain the use and adaptation of this contract form. The predominating answer was that they were not using it verbatim but were using it constantly as a guide, and the legal departments themselves adjusted the phraseology as they saw fit."

Praiseworthy Effort

J. Waldo Smith, chief engineer of the New York Board of Water Supply, showed a sympathetic attitude for the hard-working contractor by explaining how the corporation counsel of any city was inclined to encumber the contract with all sorts of binding clauses so that there was never any opportunity for the contractor to "recover" under the contract for any particular hardship and that the principal hope and guarantee of the contractor on a public works job lay in the "reasonable rulings" of the chief engineer who acts as judge on disputed points.

He said: "We are embarking on a very praiseworthy effort to simplify contracts. I presume to have eliminated any clauses which the legal profession insists on having put in and which we engineers and architects think are unfair. It seems to me you are starting out in the right way with this intention to create a framework on which the substance can later be built. That will be a distinct help and tend to eliminate a great deal of trouble that we have had in the past."

W. A. Rogers of Chicago, Ill., speaking for the Western Society of Engineers said. "I only wish Mr. Bates were here, for after many years experience as an engineer and later as a contractor, he has in recent years made his principal business a matter of arbitration. I am hopeful that this convention shall be a success, and I feel that what we have got to strive for is not a perfect document but the best one we can get. Then we can improve it year after year."

E. W. Reaugh, President of the Reaugh Construction Company of Cleveland, Ohio, described the experiences of fellow contractors in Cleveland with the standard form already introduced there by the Institute of Architects, by saying: "We find out that some of our largest contractors in the City of Cleveland have never even heard of these standard documents, and when I last reported to the Builders' Exchange that our committee considered the sub-contractors had been well represented and the general contractors had been forgotten entirely in these documents, many of them wanted to know about the standard documents and a few got copies and have been looking them over since. One large contractor reported to us: 'When we go to the architects to sign up they just tear out this first part of the agreement and pay no attention to the balance. Other architects we go to, sign up the agreement and then substitute their own general conditions. Still others look through the general conditions and so on and mark them up and change them so you can hardly tell them when you get through with them. Thus you get a set of documents which you think you understand legally and when you go to your architect he wants to change something else. It means go to the attorney every time so that you know where you are at."

William B. King, legal expert on contract forms, said: "The principal things that it seems essential to me to do are first that the people who already have standardized forms should be recognized as being the proper people to discuss the special forms relating to their business; and second, that there should be an effort (after these discussions) to get together and agree as far as possible on a uniform wording of those different contract forms."

General Marshall then spoke briefly as follows: "I just want to make a plea for the construction industry for two or three minutes. Construction has always been looked upon in this country in its elements. It has not been looked on as an industry. It has been looked on as architects, as engineers, as general contractors, as sub-contractors, as material manufacturers, as material units, as equipment manufacturers, equipment dealers, insurance men, and you can count many more.

"In thinking about this subject I naturally think about the time at the beginning of the war. There were some of us in the War Department who had to make quick progress, knowing that this construction work was necessary before soldiers could be drilled, munitions manufactured or distributed. Was there a construction industry that the nation could turn to in this crisis? There was none. Was there a standard contract that the nation could turn to? There was not, and there are 200 contracts over there in that box that you can have. That problem has been working in my mind since that time.

"Now the object to-day is, I believe, to do for the whole construction industry what the American Institute did for the building branch of it and surely the business conditions of all construction work are alike.

Loose Business

"The fact that these different things have been considered in their elements is one of the grave causes why the public looks upon construction as it does, as the most loosely co-ordinated business that the country has. No two of them think alike. The engineer does not think like the architect with respect to business conditions. Neither of them thinks like the contractor. We found at the beginning of the war that not only was this the case, but each mistrusted the other, and the attitude of the public was the same as that mistrust that you had of each other.

"That was the reason we got the newspaper notoriety that we did get, why you got the reputation that culminated in what the Graham committee said about profiteering and other things in connection with it. No set of men worked harder or accomplished more than the engineering architects and contractors did during the war, but because of that looseness of co-ordination and because there were 200 contracts where there ought to have been five or ten, and because you did not all talk the same language, although you were doing the same kind of work, you got that reputation.

"I believe there are many contract conditions that are common, that can be expressed in language carefully picked from contracts already existing, and if we can segregate these common conditions we will get a co-ordination between the professional and construction side, so that at least that much of it will be on the road to solution. This assemblage here is a plea for co-ordination in the construction industry."

The final session of the conference was devoted to a detailed study of clauses which could be approved for incorporation in the standard contract "agreement", the members voting on each topic separately until a definite list of topics had been made which seemed acceptable for universal use.

It was the consensus of opinion that such a universal document could be achieved, and its scope or length would have to be determined after prolonged consideration of each topic in detail.

It was also decided that sub-committees should later be appointed in each phase of the industry to draw up the standard form of "general conditions" (one for the railroads; one for the builders; etc.) which would complement the general "agreement" according to the nature of the job.

Standard Specification for Wire Rope

The Canadian Engineering Standards Association Drafts a Code Covering Wire Rope for Mining, Dredging and Steam Shovel Purposes

The specification is intended to embody those requirements for standard grades of wire rope for mining, dredging and similar purposes, which are regarded as essential in order to protect the purchaser against an inferior or defective product, and to guide the manufacturer or importer as to standard practice in Canada.

It was at first considered that separate specifications should be prepared for rope for mining, and for rope for dredging, etc., but on examination, the governing conditions for both kinds of work were found to be so far in agreement, that the specifications were combined.

The classification of material adopted, recognizing three grades of steel, is in accordance with the practice now usual in Canada. At the desire of the manufacturers' representatives on the Committee, the customary term "crucible cast steel" has been retained as the description of a particular grade of material, although the committee realizes that its employment is not in accordance with metallurgical usage.

The sectional committee on wire rope was appointed in 1919 by the main committee, on receipt of a request for standardization work on wire rope from one of the government departments. The present specification was completed by the sub-committees in March 1921, was approved by the sectional committee in June, and its publication was authorized by the main committee in August, 1921.

General

1. This specification covers the standard grades of steel wire rope for the purposes named above.

2. Wire rope purporting to be manufactured in accordance with this specification shall be known as "C. E. S. A. Standard Hoisting Rope" or "C. E. S. A. Standard Hauling Rope" as the case may be, and may bear the distinguishing mark of the Association.

3. At the time of placing the order the purchaser will furnish to the vendor all necessary information regarding the conditions under which the rope is to be used, and the kind of service for which it is to be employed, together with other particulars as enumerated in appendix 1.

4. In tendering, the vendor will furnish the purchaser with information regarding the construction of the rope which he proposes to supply, as set forth in appendix II, and shall, at the same time, furnish a written guarantee regarding the ultimate tensile strength of the finished rope.

5. The term "vendor" throughout this specification shall mean the seller of the wire rope, whether he be the manufacturer of the rope or not.

Manufacture

6. The following shall be the recognized grades for material for wire for C. E. S. A. standard ropes: crucible cast steel; plough steel; and special plough steel.

7. The term "crucible cast steel", as here used, is intended to imply an acid or basic open-hearth or Bessemer steel of medium carbon content.

8. The terms "plough steel" and "special plough steel" as here used, are intended to imply a high-grade acid open-hearth steel somewhat higher in tensile strength than the crucible cast steel, and of higher carbon content, say, 0.50 and upwards.

9. The three grades of material, as here classified, shall be such that the wire made from them will have the following ranges of tensile strength:—

Crucible cast steel..	160,000 to 210,000 lbs. per sq. inch
Plough steel......	200,000 to 230,000 lbs. per sq. inch
Special plough steel	220,000 to 270,000 lbs. per sq. inch

10. Methods of manufacture of the wire itself, of the strands, and of the completed rope, shall be such as to ensure that the finished product will conform to all the requirements hereinafter specified.

11. The wire shall be drawn from mild homogeneous steel, shall be uniformly heat-treated, and, if galvanized rope is required, shall be effectively galvanized as specified below under "galvanizing".

12. The rope shall be laid up evenly and uniformly throughout as regards size, and shall show evidence of proper and uniform tension on the strands during manufacture. The number of wires and strands, and the angle and lay of wires and strands shall be as approved by the purchaser.

13. If the construction of the rope is such as to call for filler wires, these, if of different material to the other wires of the strands, shall not be considered as contributing to the strength of the rope.

14. Joints in wires composing the strands shall be distributed as widely apart as possible, and in no case shall more than one such joint occur in a length of 50 feet of strand.

15. The use of tucked joints is not recommended.

16. Lengthening of a strand after manufacture to make it suitable for use in laying up a rope longer than originally intended will not be permitted.

17. The central core of the rope, unless of wire, and the cores of the several strands, if used, shall be of Manilla or New Zealand hemp. Jute cores will not be accepted. The cores shall be carefully laid up, shall effectively support the strands or wires, and shall be thoroughly impregnated during the manufacture of the rope with a preservative mixture which will have no injurious effect on the wires or the material of the cores.

18. Both the individual strands, and the rope, while being laid up shall be thoroughly impregnated with a suitable lubricating compound which shall have no injurious effect on the wires or the material of the cores shall not gum, and shall be of the proper consistency to be retained in the interstices of the strand or rope.

19. When the rope is purchased by weight, the purchaser shall be satisfied that no excess preservative or lubricant composition has been used.

20. If galvanized rope is required, the galvanizing shall consist of a continuous coating of pure zinc of uniform thickness, which shall adhere to the wire and shall present a smooth surface.

Physical Properties and Tests for Wire

21. The ultimate tensile strength of the wire

shall comply with the following minimum requirements.—

Crucible cast steel	160,000 lbs. per sq. inch
Plough steel	200,000 lbs. per sq. inch
Special plough steel	220,000 lbs. per sq. inch

and shall in no case be less than the values stated by the vendor in his tender for the sizes of wire to be used.

22. For the purpose of computing the ultimate tensile strength of wire for galvanized rope, the effective cross section of the wire shall be taken as 90 per cent of the gross area of cross section including that of the zinc coating.

23. The tensile strength of the wire shall be determined by means of a testing machine approved by the purchaser.

24. Samples for the tensile tests of wire shall not be less than fifteen inches long and free from bends and kinks.

25. The wire shall be cylindrical and smooth, and its diameter (after galvanizing, if galvanized wire is called for) shall be uniform within the following limits:—

	Tolerance	
Nominal Diameter	Above Nominal Diameter	Below Nominal Diameter
.064 inch and larger	+.005 inch	Nil
Below .064 inch	+.003 inch	Nil

26. The diameter of the wire shall be determined by gauging with a micrometer at at least three places on each coil. The size of wire shall in all cases be expressed in decimals of an inch, using not more than three places of decimals, that is, in mils. Wire which measures below the nominal diameter will not be accepted.

27. A sample from each coil of the wire (after galvanizing, if galvanized wire is called for) shall be tested in torsion and shall withstand without breaking or showing any signs of splitting or other defect in the wire itself, a number of complete turns not less than the number given by the following table:—

Kind of Wire	Turns per length of 100 diameters
Galvanized	15
Ungalvanized	25

28. In the case of wire for galvanized rope, this torsion test shall not be construed as in any sense a test of the galvanizing.

29. The torsion tests shall be made as follows:—The piece of wire shall be gripped by two vises, one of which shall be stationary, while the other shall be free to move longitudinally, and shall be rotated steadily at a speed not exceeding one revolution per second. The full number of twists shall be distinctly visible between the vises.

30. Samples for torsion tests shall be straight and not less than ten inches long.

31. All tests, as specified above, shall be made upon fair samples, which may be selected by the purchaser's inspector or authorized representative from any portion of any coil of wire.

32. When samples of wire are taken from the coils before the rope is manufactured, such samples shall be taken from not more than 10 per cent of the total number of coils, and tensile and torsion tests shall be made thereon as specified above in paragraphs 21 and 27.

33. When finished rope is offered for sale by the vendor and it is therefore impossible to carry out the tests specified above on the wire before it is laid up into strand, the inspector may select the necessary samples of wire from the finished rope, cut from such portions of any length of rope as may be agreed upon between the vendor and the purchaser, and one set of tests as specified above shall then be carried out upon the wire taken from each length.

34. If, upon testing a sample of wire from any coil of wire or length of rope, that sample is found not to fulfill one or both of the tests specified above, similar tests upon two additional samples from the same coil or length shall be made. If both the additional samples fulfill the test or tests, the lot of wire or rope which they represent shall be accepted. If either of the additional samples fail, further tests may be made at the discretion of the inspector, on samples from other coils or lengths of the same lot, and the purchaser may accept such coils at his discretion.

Physical Properties and Tests for Rope

35. The diameter of the rope when delivered, as measured over the extreme outside wires, shall in no case be less than the nominal size, and shall not exceed same by more than 3/32 of an inch in the case of rope one inch diameter and larger, or by more than 1/16 inch in ropes of diameter smaller than one inch.

36. The ultimate tensile strength of the finished rope shall in no case be less than that guaranteed by the vendor.

37. Check tests of the tensile strength of samples of the finished rope may be made by the purchaser at his own expense, and if so made, shall be carried out on specimens prepared in accordance with the method set forth in appendix III. Failure in these tests to meet the vendor's guarantee shall be cause for objection.

38. The vendor shall, if required, furnish free of cost a copy of any document in his possession showing the results of any tests made for him or for any other person on the rope, or on the material for the rope, sold or offered for sale to the purchaser.

39. He shall also, if required at the time of purchase, furnish free of cost a certificate that the rope has been tested, and that such tests comply in all respects with the requirements of this specification.

40. The furnishing of such copies of documents, or the giving of such certificate, shall not preclude the purchaser from rejecting any rope which does not compy with this specification.

Standard Constructions

41. The following are recognized as standard constructions for C.E.S.A. standard wire rope:—

Hoisting	Haulage
6 x 19	6 x 7
6 x 19 Seale type	6 x 12
6 x 37	6 x 19 Seale type.

Workmanship and Finish

42. The wire shall be free from scales, flaws, inequalities, splints, and all injurious defects, and shall be of smooth uniform finish.

43. The completed rope shall be free from injurious defects, evenly laid, and free from kinks, loose wires, open strands or other irregularities, and shall remain in this condition when unwound from the reel or coil, or bent around a standard thimble, provided that proper precautions are taken, and the ends are properly secured.

Packing and Marking

44. All rope shall be furnished on reels unless otherwise specified by the purchaser, and shall be suit-

ably protected to avoid damage during shipment.

45. A metal tag shall be securely attached to each reel or coil and stamped with the maker's name, diameter of rope, grade of material, weight of rope, length of rope, and C.E.S.A. distinguishing mark.

Inspection and Rejection

46. The Inspector, representing the purchaser, shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the rope ordered.

47. The manufacturer shall afford the inspector, free of cost, all reasonable facilities to satisfy him that the wire and the rope is being furnished in accordance with this specification.

48. All tests and inspection shall be made at the place of manufacture of the rope, and prior to shipment, unless otherwise specified by the purchaser, and shall be so conducted as not to interfere unnecessarily with the operation of the manufacturer's works.

49. The manufacturer shall provide at his works, free of cost, all apparatus and labour for making the required tests under the supervision of the purchaser or his inspector. This requirement shall not apply to the tests specified above under "tensile tests on finished rope".

50. Rope which does not conform to all requirements of this specification will be rejected.

* * *

Appendix I—Information to be furnished by the purchaser to the vendor:—

1. Purpose for which rope is required.
2. Length of rope required.
3. Size (diameter or circumference) desired.
4. Grade of material desired—Crucible cast steel, plough steel, or special plough steel.
5. Lay (regular or Lang's) desired.
6. Whether right or left lay.
7. Whether galvanized or not.
8. Maximum running speed.
9. Maximum working load.
10. Diameter of smallest sheave over which rope will run.
11. Form and dimensions of groove in sheaves.
12. Nature and arrangement of lining material in groove (if any).
13. Whether subject to reversed bending in operation; if so, sketch showing arrangement and diameters of sheaves is to be given.
14. If to be wound on drum, minimum diameter of same, and number of layers of rope.
15. Whether to be delivered on reels or in coils.
16. Whether all tests will be made at manufacturer's works before shipment.

* * *

Appendix II—Information to be furnished with his tender by the vendor to the purchaser:—

1. Grade of material of wires, and of filling wires (if any).
2. Size of rope.
3. Number of strands.
4. Number of wires in strand.
5. Nominal size of wires and filling wires (if any).
6. Nature of material of core.
7. Nominal weight in pounds per foot of rope.
8. Ultimate tensile strength of wire (to be stated for each size of wire used.
9. Guaranteed ultimate tensile strength of completed rope.
10. Location and particulars of testing machine available for tensile tests of wire.
11. Gross weight of rope as packed for shipment.

* * *

Appendix III—Method of Preparing Specimens for Tensile Tests on Completed Wire Rope:—

The test pieces for tensile tests on completed rope must be free from initial bends and preferably not less than eighty inches in length between sockets. In preparing the test specimens for socketing, at least two seizings or servings of soft iron wire, each about one and one-half inches long, are placed tightly upon the rope at a distance apart equal to the intended length of the test specimen between sockets. Two similar additional seizings are placed beyond the first two and at a distance from the first equal in length to the socket, this length usually being from five to nine inches in a range of diameter of rope of say one-half inch to one and one-half inches.

If the ends of wire rope are not properly secured, the original and uniform relation of tensions obtained by correct manufacture will be disturbed. Hence it is most important that proper seizings shall be placed at each side of any point at which the rope is to be cut. If possible two, or, better, three, seizings should be employed at each side of a cut. Annealed iron wire should be used, the suitable sizes being from .054 diameter for rope one half inch diameter up to .080 for rope one inch diameter and .105 for rope two inches diameter.

After the specimen is served as described, it is cut from the coil of rope, and each end is slipped into a cast steel or forged steel socket, the outer dimensions of which suit the holders of the testing machine to be employed. The inner surface of the socket is conical, with a taper of about one in four on the diameter. The ends of the specimen are next to be broomed out and secured in the sockets, as follows:—

After the sockets are placed on the specimen, it is clamped in a vise, the end serving wire removed, and the strands and wires carefully opened or frayed out as far as the second serving. The core of the rope is removed for a distance equal to the length of the socket. Individual wires are next thorougly cleaned with waste and the free use of gasoline, and are then carefully wiped to ensure their freedom from any trace of oil which may occasion slipping of the wires in the zinc filling. If the rope contains much lubricant, it may be desirable first to wash the frayed out portion in caustic soda solution, but this is not necessary when the lubricant is carefully removed and the wire carefully cleaned with gasoline. A portion of the wires may be bent back on themselves at the ends for an inch or two in order to ensure a good bond in the zinc.

If difficulty is found in obtaining proper adhesion of the zinc filling to the wires, after cleaning with gasoline and wiping they may be dipped in dilute hydrochloric acid and wiped dry with a clean rag.

The specimen is next to be held vertical and truly axial with the socket, and adjusted so that the frayed out wires lie as evenly distributed as possible within the cone-shaped cavity of the socket. A small ring of fire clay may be used at the base of the socket to prevent seepage of molten metal along the rope. Commercial spelter may be used for filling the socket. It should be heated to a temperature just sufficient to give a good degree of fluidity, but must not be too hot, otherwise the wires in contact with the molten zinc have their strength impaired by the heat. This difficulty occurs more especially on small diameter specimens (one-quarter to one-half inch diameter), on account of the annealing effect on the small wires. The melted zinc should be ladled as rapidly as possible in order to ensure a uniformly cast filling for the socket.

In applying a load to the test specimen, the rate of application must be very slow during the earlier portion of the loading. thus permitting the strands and wires to bed properly upon one another.

The Maintenance of Clean Filtering Medium in Sewage Filters

By HERBERT D. BELL, Manager and Chemist, Barnsley (Eng.) Sewage Disposal Works, before the Association of Managers of Sewage Disposal Works

In view of the research which is being carried on at the present time on methods of sewage purification, without filters—I refer, of course, to the use of activated sludge, whether by the air-blowing method at Manchester, or by the processes of the paddle-wheel at Sheffield, or the screw at Bury—there still remains a wide field of investigation on the possibility of the maintenance of filters, without having to resort to mechanical washing of the material at the end of every ten to fifteen years. It is with regard to the latter subject that I have something to say, which I trust will help other managers to keep their filtering medium clean, in order that sewage filters may continue to carry out the function for which they were designed.

My remarks apply chiefly to the media in percolating filters, although contact filters may also derive benefit from the process of cleaning which I am about to describe. As a foreword, this paper does not pretend that all kinds of filtering material will last for ever, but presupposes that the material of which the filtering media is composed is able more or less to resist frost and the ordinary natural forces, and is composed of, say, furnace clinker, slag, saggers, and such like media.

On many of the sewage works under your control there may be some filters which are showing signs of clogging up, the first notification of which is generally a ponding of the tank effluent on the surface of the filter. Some of you may have filters which apparently do not seem able to do anything else but pond, and no amount of rest appears to give them any relief. You may also have filters which pond only under stress of work or only during the winter months. To all who have the control of percolating filters with automatic or mechanically driven distributors, or fixed sprays, I suggest a means of cleaning the surface and the lower strata of the media by means of an insect called Achorutes viaticus, or the water springtail. In a publication entitled "Insect Life on Sewage Filters" it was demonstrated that this insect would prevent the formation of gelatinous or greasy growths on the surface of circular percolating filters, which cause the formation of impervious layers, thus producing ponding. Further it was also proved that if a filter became so foul on the surface with these growths that it was quite impervious to tank effluent, the addition of these insects caused the breaking up of these growths, and gradually (on complete colonisation) brought the filter media back to its pristine cleanliness. It is evident therefore that the presence of these insects extend the life of the filter, and enable it to work for longer periods without rest, and also to produce a higher percentage purification.

The Use of Insect Life

The experiments referred to in "Insect Life on Sewage Filters" (The Sanitary Publishing Co., Ltd.) were carried out with wide glass tubes for filters, and well graded, sterile cinders, constituting the media, the top three inches being cinders which passed through a ¼ in. mesh, but were rejected by ⅛ in., the latter being much finer material than is generally found in practice. At no time did the filter, in constant possession of Achorutes viaticus show signs of ponding, although worked at a higher rate than the other filter, which contained exactly similar medium, and grading, but did not possess any of these insects. The latter filter soon commenced to show signs of ponding, which did not disappear with resting, and eventually became quite impervious to tank effluent. On the addition of these insects to the dirty filter, the surface began to clean up, and after a few weeks became quite clean down to the bottom of the filter. The surface of neither filter was disturbed in any way throughout the whole experiment.

At Stratford-on-Avon the insects appeared on the filters naturally, or rather I sould say on one of the filters, and their number increased to such an extent that 133 bucketsful were obtained from the pathway surrounding this particular filter. The other seven filters were treated to 19 bucketsful each, and from February, 1910, to this day, no fork, rake or other implement has been used to lessen the surface of these filters, neither do they show any signs of ponding during the last three or four years before I left Stratford-on-Avon.

These insects did not appear naturally at Barnsley sewage works, but I was able to procure one or two tins full from my friend Mr. D. Robertson, manager of the Darfield sewage works. Some of these insects were put immediately on to very dirty patches on the surface of one or two filters, and the remainder were transferred to the fine surface of an experimental pipe filter, to which was added, by means of a small syphon, tank effluent six days per week for some months. This small filter acted as a colonising or propagating filter, and from time to time a handful of media containing the eggs of the insect were transferred to dirty portions on the large filters, until at the present time there are three large filters well colonised, and the remaining filters are showing signs of healthy propagation. None of the nine large circular percolating filters on the Barnsley sewage works have been forked since the summer of 1919, and ponding is gradually becoming less frequent, and is in fact absent on those filters which are well advanced in colonisation of Achorute viaticus.

Forking as a Cause of Clogging

It has been somewhat of a passion amongst sewage works managers, immediately after a filter began to pond, that it was necessary to fork up the medium at that particular point, and in some instances I have known of forking taking place whilst the filter medium was wet. For many years I have held that forking or disturbing the surface in any way was a fallacy, and further I believe that forking in many cases has been mainly responsible for the clogging up eventually of many filters in this country, and I propose to give you my reasons for this assertion.

If a fork is plunged into the medium, and its contents lifted and turned over, as is done when forking a garden, it tends to disintegrate a portion of the growths, so that on restarting work again on the filter after its rest, the finer portions of the medium which are still partially covered with the growths (referred to before) are washed by the tank effluent lower down into the filter, becoming retained by the dirty portion of the coarser material below, which is at a point beneath which the fork will not penetrate on the next occasion. These growths will then start once more to produce an impervious layer beneath the surface. At the same time, the medium on the surface will become pieced together with these growths, thus re-forming an impervious layer on the surface.

With these two layers of growths increasing on two planes one immediately above the other, no air can get through, and the result is that no aerobic organisms can live or be propagated, and finally clogging becomes permanent on that portion of the filter, unless some biological force comes into play.

There are on many filters a large number of worms, and undoubtedly they do much useful work in keeping numbers of air-channels open, and also there must be other forms of life other than bacteria which help to produce a state which lengthens the period before actual total clogging becomes general. During resting periods a little disintegration undoubtedly takes place, but the general result is that the growths causing the clogging being out of sight (after forking) are believed to be absent. Thorough disintegration cannot take place without biological forces, and no mechanical loosening of the surface, in my opinion, will prevent the gradual clogging up of the media, which as time goes on renders the filter less useful as a purifying agent, and finally the whole of the material is taken out and washed or renewed before replacing in the filter.

Some of you may say, "We do not fork a filter medium like we fork a garden." Perhaps you do not. You may insert your fork vertically downwards, and gently prise the handle backwards with a slight jigging movement, bringing the fork out so as only to sift the dirt in the tight medium. The effect is the same as in the other method, but perhaps tends to delay a little longer the actual clogging up of the media, as a large proportion of the fine media remains on the surface; but the sifted particles being coated with some of the growths settle down on the coarser medium below and re-form at a level below which the fork will not reach on the next occasion. Further, the act of forking tends to destroy the original grading of the media, as a properly constructed filter should have from four to six inches thick of its finest grade of material on the top. Forking causes a distribution of the fine particles of the material, coated with these objectionable growths, to intermingle with the coarser material below the surface, which consequently impedes partly purified liquid from getting away from the top layer of the coarser material and therefore these dirty particles tend to absorb from the partially purified liquid some of its oxidised nitrogen and oxygen, to the detriment of the final effluent leaving the filter. . . . .

If for any reason you have been unable to obtain the necessary biological organisms to keep your filters clean, it would be far better to remove entirely the top layer, wash and then replace it after screening, rather than to fork the surface at all. The best way, I consider, is to try to colonise your filters with some form of life, which not only disintegrates and removes objectionable growths which have formed, but will also prevent the re-formation of such growths. Sewage filters, as most of you know, are not straining filters like waterworks filters, but purification is produced by active contact with purifying organisms which can only carry out their functions in the presence of air, and therefore the more porous the fine surface of your filters can be maintained, the more likely will purification be carried on with success, and the life of the filter extended before the ultimate breaking up of the filtering media renders its renewal imperative.

Colonisation of "Achorutes viaticus."

As stated above, the Achorutes viaticus did not come naturally to the filters at Barnsley sewage works and, furthermore, the media is such that it does not offer the same cavities for the protection of the eggs and the young insects as ordinary furnace clinkers; yet in spite of this handicap we have been able to get colonisation complete on one filter, nearly complete on two others, and evidence of the presence of these insects on the remaining six filters within a period of two years.

The total capacity of all the circular filters at Barnsley is 15,790 cub. yards. These filters deal with a tank effluent whose average dry-weather flow is approximately 1⅛ million gallons, and as much as 2,900,000 gallons have been dealt with by these filters in twenty-four hours, so that it is possible for other managers with larger works than I control eventually to colonise their filters with this insect, certainly within a period of three or four years.

During the period of colonisation it will be noticeable, first, that ponding will become less frequent until it disappears altogether; secondly, that there will be a gradual increase in the volume of tank effluent which the filters will be able to cope with and purify; thirdly, there will be noticed an increase in the percentage purification (after settlement); and, finally there will be noticed an increase in the amount of suspended matter passing away in the effluent from the filter. Generally speaking, there should be a larger amount of suspended matter in the effluent from a percolating filter than in the tank effluent distributed on to its surface, as, given that the surface is porous, particles of suspended matter in the tank effluent should be able to pass through, and in addition there will be a breaking up of the colloidal matter in the tank effluent, a portion of which will be changed into suspended matter.

These are the signs of partial colonisation while the filter is at work, and when it is resting it will be noticed that within three days (on circulating filters) that concentric rings appear on the surface of the media. These rings are of two varieties, the one being clean and the other dirty or discolored. On examination of the material with a penknife immediately below the surface of the clean ring, either there will be found large numbers of the insect at work, or there will be found large numbers of its white cast or sheath, showing that the adult insect has moved to a portion of the media where there is more food—that is, where there is a greater deposit of the growth which has been the immediate cause of the dirty appearance. At the place where these white casts or sheaths are found, the eggs of the insect can be seen with the aid of a small magnifying glass, and appear to be in packets of small globular cells. As resting continues and colonisation has become more complete, the whole surface of the material will appear to be even cleaner than it was before placing in the filter, and also several inches below the surface will bear out the same result. If colonisation is approaching its zenith, large numbers of these insects will pass out with the effluent from the filter, and as the insect is capable of standing on the surface of a liquid by means of the hairy ends of its legs, it is an easy matter to collect them in a ladle or bucket with the effluent for distribution on filters where their number is not so numerous.

Maintenance of Clean Medium in Sewage Filters

Transfer of Insect

The transfer of Achorutes viaticus to filters on other works is more difficult, especially if it is necessary to send them by rail. The adult insect does not carry well, and there is generally a high mortality if they are carried by rail. In order to provide a nucleus for inoculation of filters several miles away, I have found that it is better to take a portion of filtering media well stocked with eggs, packing it in a 7 lb. biscuit tin with moist green grass, and the box filled up with moist grass packed loosely on the top. This will give the material and eggs both moisture and air until they arrive at their destination. On arrival the grass should be taken off the top, a cavity made in the surface of the filter about to be inoculated, and the media containing the eggs gently transferred to the cavity in the surface of the filter prepared. Carefully note the spot where the material containing the eggs has been put, and watch it from time to time for the next three or four days. One morning you will notice that the material begins to clean up in the immediate neighborhood, giving evidence that some of the insects have hatched out in their new environment and have got to work, and in the next few days there will be no apparent sign of any insect on the surface, as they work for the most part immediately below the surface out of strong air currents and where they are not likely to be sprayed by liquid. Gradually the area round this spot in which the eggs were first placed will show signs of cleanliness, and if this spot was the centre of a previous ponding place it will be noticed on restarting the filter to work, that ponding becomes less at this point until it finally disappears altogether.

The adult insect is only about two millimetres long, and four million weigh one pound. By means of the hair on their bodies they attract a bubble of air when becoming immersed in a liquid, and being enveloped by the bubble they float to the surface and become liberated on the surface when the bubble bursts. Otherwise they are unable to live under water. I have not seen many of these insects on a contact filter, and do not think they would colonise easily on a contact filter as the method of filling would tend often to immerse them in the liquid. Occasionally one finds them on a storm bed which is only used intermittently or as a streaming filter during wet weather and has long resting periods.

Other Experiments

These insects are being used in experiments at Glasgow, where the chemist in charge, Mr. F. W. Harris, F. I. C., hopes at a future date to colonise filters at these works. He believes, as I do, that filters can be worked more satisfactorily with the presence of achorutes in the filtering media and is now experimenting with them for a method of colonisation. As I have stated before, there were no evidences of the presence of these insects at the Barnsley sewage works when I took up my appointment there in November, 1919, and it has therefore given me great pleasure to be able to glean from my stock of the insects sufficient to form a nucleus to send to Mr. Harris to start his experiments, and if at a future date either he or any other manager wants any more I shall be in a position to supply them. Mr. Harris has not yet published any report of his experiments, but when he does I have no doubt that the insect Achorutes viaticus will come in for a large share of appreciation as a means of maintaining high purification, and as an agent for increasing the volume of purified effluent per cube yard per day. Dr. Buxton Flint, medical officer of health for Buxton, has also this year received from the Barnsley sewage works a nucleus for colonisation of filters at Buxton. Other works in which I introduced this insect some years ago are Macclesfield, Tiverton, Maidstone, and several small installations near Stratford-on-Avon, and on these filters the insects have done very useful work.

Glasgow Colonisation Method

I advise the setting up of small experimental filters with a fine surface as a colonising filter, and using this as required for the propagation of the insects on large filters.

Mr. F. W. Harris, of Glasgow, has devised a better method of inoculation, consisting of a shallow wooden box with a perforated loose bottom 1 ft. square by 6 in. deep. This box is filled with the same medium of which his large filters are composed, and is suspended immediately below his experimental filter. The latter is colonised by the liquor which passes through the experimental filter, as it carries with it small insects, white casts (or sheaths) and eggs, and thus colonises the medium in the box. Mr. Harris finds that it takes about three weeks to affect colonisaton of the medium in the wooden box, and when this time has elapsed he transfers the box to one of his large filters, making a cavity in the surface of the media large enough to take the box. The box is then put into the cavity, the media levelled up on three sides, the loose bottom drawn out and the media levelled up against the fourth side. The four sides are then lifted up, and inoculation is thus made with the least disturbance of the media. As the liquor is sprayed on to this media the insects are washed out into the media immediately below, and colonisation com-

No. 33

Canada's Contractors—Wm. I. Bishop

William I. Bishop is one of the outstanding figures in the construction industry, his name having been intimately connected with some of the most important projects carried out in Canada and the United States in the last twenty years. He has a variety of interests, for besides being president and managing director of Wm. I. Bishop, Limited, constructing engineers, of Montreal, he is president and managing director of the Raymond Concrete Pile Co., Ltd.; president and managing director of the Ambursen Hydraulic Construction Co.; vice-president of the Pacific Construction Co.; vice-president of the Pacific Dredging Co., and a member of the Quebec Streams Commission. Mr. Bishop was born in Montreal in 1875, and a great deal of his work has centred around that city. In his early days he was articled to Jos. Rielle, P.L.S., of Montreal, and engaged in other surveying and drafting activities. In 1895 he became chief assistant to T. Pringle & Co., leaving them six years later to become superintendent of construction for the Aluminum Company of America, Pittsburgh, Pa. In 1905 and 1906 he was general superintendent for T. A. Gillespie, Whitney, N.C., following which he was president of the Bishop Construction Company of Montreal for a number of years. Mr. Bishop then engaged in private practice as a consulting engineer in Montreal, and in 1916 joined James Stewart Company of Toronto as general superintendent. In 1917 and 1918 he was division manager for the Foundation Company, Victoria, B.C., and New York. He then became managing director of the Raymond Concrete Pile Company of Montreal, and later established the firm of William I. Bishop, Ltd., with which the Raymond Concrete Pile Company and the Ambursen Hydraulic Construction Company are affiliated.

Mr. Bishop has been very active in many large construction operations. On the original development at Shawinigan Falls he was resident engineer, and he was also responsible for the design of La Loutre (now the Gouin) storage reservoir at the head of the St. Maurice River, P.Q., the largest in the world. During the war he was manager of a group of five shipyards, building steel and wooden vessels for the Allies. He was also responsible for the organization of the Southern Canada Power Company and the Public Service Corporation of Quebec.

Mr. William I. Bishop

mences in the large filter. Mr. Harris adopts this process also for cleaning up dirty portions of the media, and I consider that it is a very good way to assist colonisation with the least number of casualties." It is, of course, necessary first to establish the insects on an experimental filter.

Dispensing with Washing

I trust that this paper may arrest some of your activities with regard to searching for cheap washing plants and help you to choose a different method of cleaning your filters and of keeping them clean. If, however, some of you are in the middle of mechanically cleaning the surface and lower strata of your filters, I trust you will take all steps necessary to colonise your new or washed material with achorutes, and thus prevent the need for washing at a future date, unless, however, the material itself breaks down and disintegrates. Achorutes are not the only form of life which do good work on sewage filters, but I am not sufficiently enlightened with regard to what share the other mediums take in the process of medium cleaning. Neither do I attempt to state that cleaning of material and good working of filters cannot be done unless this insect is present; but what I do state and what I have proved is that with Achorutes present on one filter and absent on another, each dealing with the same tank effluent, the one containing Achorutes viaticus will have a cleaner surface, an absence of ponding and clogging, and be able to deal with a larger volume of tank effluent per day, giving it a higher percentage purification than the filter in which achorutes are absent. I have proved that a dirty filter can be cleaned without handling or loosening the surface by means of this insect, and that colonisation is possible on many kinds of filtering media.

Cement Association Bases Membership on Quality of Product

At the final session of the Annual Meeting of the Portland Cement Association, which was on December 12 to 14 in New York, the association's constitution and by-laws were amended so as to make membership in the association "contingent upon member's product meeting the standard specifications for portland cement adopted by the United States Government and the American Society for Testing Materials."

Along with other scientific-educational-research activities, the Portland Cement Association is distinguished for its co-operative work with technical societies. This has been in the nature of contributing to the improvements of building materials, methods and standards in general, among these being building codes, but the association has particularly been active in keeping standard requirements for portland cement on a high plane and in insuring its proper use by the consuming public.

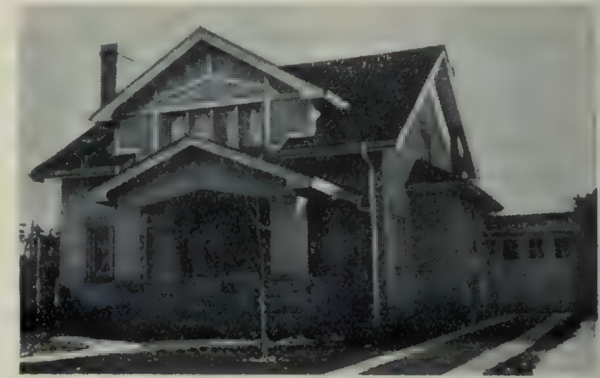
A House Plan Suggestion

One of a Series of Designs Presented from Time to Time in the Contract Record

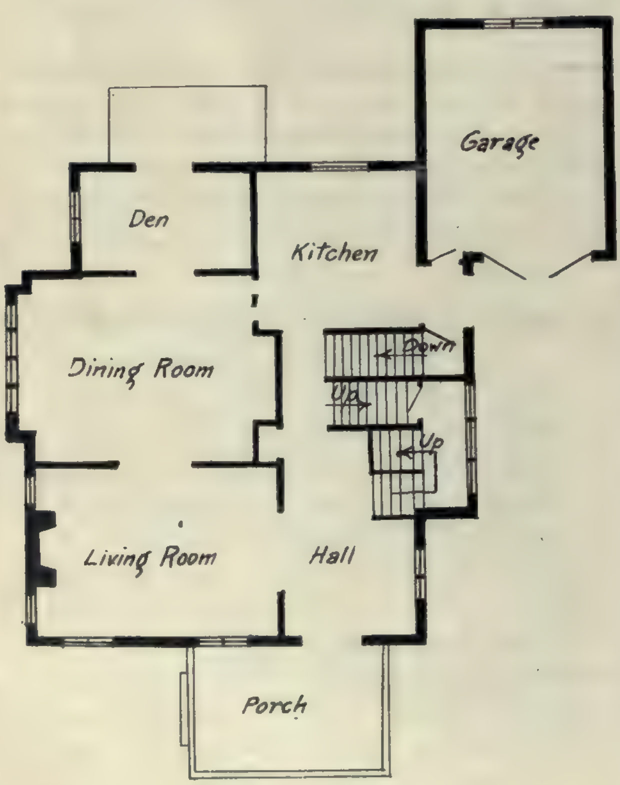
The very attractive residence, illustrated and described herewith, is a style that may profitably be adopted by builders who are interested in the residence side of contracting work. This house is of solid construction with stucco walls, with Indiana limestone trimming on the base, chimneys, sills and heads. A garage is a unit with the house and other external features are a large open verandah at the front and a pergola off the den at the rear. Stained shingles have been adopted as a roof covering.

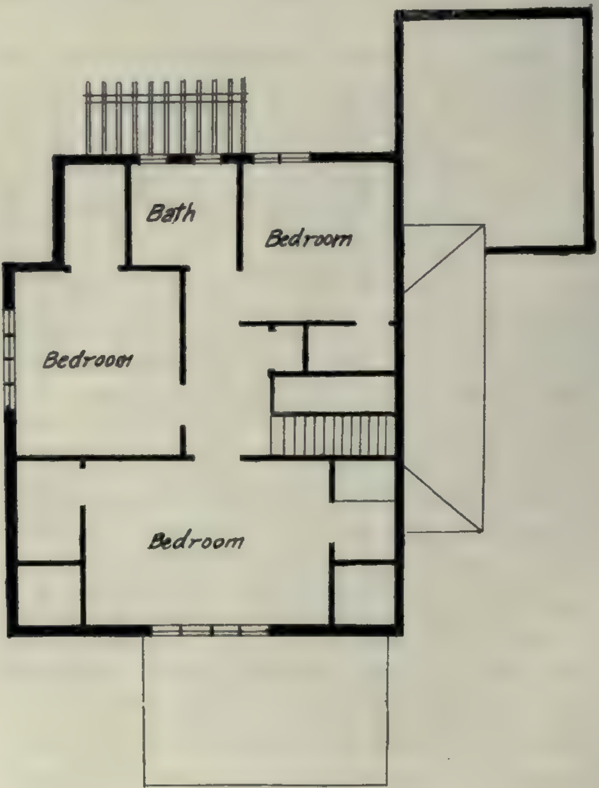
A basement comprising furnace room, laundry, coal bins and separate fruit cellar, occupies the whole house area. Furnace is of the hot water type. The ground floor, containing a large living room and dining room, den and kitchen, is trimmed, with the exception of the kitchen, in chestnut. All ceilings, excepting the kitchen, are closely beamed. The living room, entered from the hall through large doors, contains a large open fireplace of brick construction. The dining room, which adjoins the living room and connects with it through large French doors, has a built-in buffet. The main stairway is screened with panel and trellis work. The kitchen is completely equipped for domestic service and includes built-in cabinets and ironing board.

The bedroom flat has three large and well lighted bedrooms, the front room having two exceptionally large closets. A large linen closet in the hall provides ample storage. Oak floors are used throughout.



This house was built for Mr. George Bryant, by Mr. George W. Wilson. It is located on Inglewood Drive, Moore Park, Toronto.





Mainly Constructional

East and West—From Coast to Coast

Premier Drury it is announced, has notified the building trades council at Toronto, that the provincial administrative building to accommodate certain government departments, will be erected in Toronto in the early future.

The City Council at Toronto has decided to install an ice plant in the new Live Stock Arena, at the Exhibition Grounds, at a cost of $100,000. This will make the third artificial ice rink in the city, and will be the largest structure of its kind on the continent. The ice plant will be used for making ice for domestic purposes in the summer time.

The total value of permits issued by the building department at Montreal, for the year just ended, passed the $21,000,000 mark, an increase of approximately $7,000,000 over the 1920 figure. Montreal's record building year was 1913, when construction work to a value of approximately $27,000,000 was carried out. However, last year's increase was very satisfactory and prospects are even brighter for 1922.

The Lakeshore Boulevard, from Dowling Avenue to the Humber, at Toronto, part of the big development scheme being carried out by the Harbor Commission at Sunnyside, was recently opened by Ex-Mayor Church. Several officials of the Harbor Commission and the City Council, and many prominent citizens were present at the ceremony, which was followed by a dinner at the Sunnyside Pavilion.

The Builders' Exchange at Montreal has definitely approved of the scheme to hold a building exhibition in that city some time during the month of February. It is believed this exhibition will do much to encourage building during the present year and will give the public an opportunity to become acquainted with a number of new construction materials that have appeared on the market during the past few years.

Many alterations and improvements have been carried out at the new Parliament Buildings at Ottawa during the period of prorogation. Stone masons have been at work on the Peace Tower, Hall of Fame and the Court of Honor, into which the main entrance opens. This latter improvement has resulted in a much more imposing entrance. The main entrance will be in use for the first time at the opening of the next session.

The City Council at Ottawa recently endorsed the new building by-law. Among the important changes noted in the new by-law is a clause permitting the use of stucco or metal walls in garages, instead of the solid construction hitherto required, providing these buildings are erected at a distance of 20 ft. or more from any other structure. Another change in the by-law puts the city plumbing department in charge of the inspection of heating plant apparatus in new buildings.

Another large hotel is rumored at Quebec, P. Q. Mr. C. J. Lockwell, representing the Canada Hotels Company, it is reported, recently waited on certain city officials and submitted a scheme for the erection of a 10-storey hotel to cost between $1,500,000 and $2,000,000 on Montcalm Market. This company, Mr. Lockwell stated, intends erecting a string of eight hotels in large Canadian cities including the following: Quebec, Montreal, Toronto, Three Rivers, London and Kingston.

The Housing Commission at Hamilton reports that applications for loans are continuing to pour into the Commission's offices, but at present the city has no funds for this purpose. Mr. Wm. Campbell, secretary of the commission, recently stated that many applicants were willing to pay cash deposits of 20 per cent. of the loan, instead of the required 10 per cent. It looks as if it would be good business for the city to apply for a portion of the Ontario loan immediately to finance the building program resulting from the applictions on hand, which it is estimated, would entail an expenditure of $150,000.

The report of the building department at Toronto for the past year shows building permits issued to a total value of about $20,000,000, made up as follows: 2,908 brick dwellings, $12,856,650; 95 frame dwellings, $192,000; 121 brick and roughcast dwellings, $301,800; 5 apartment houses, $37,500; 3 bank branches, $63,000; 7 churches, $164,000; 7 club houses, $158,000; 15 factories, $310,500; 3,078 garages, $1,143,985; 6 new schools, $549,500; 40 school alterations, $1,387,325; 262 stores, $1,880,000; 1 theatre, $125,000; 2 car barns, $485,000; addition to Williard Hall, $115,000; pure food building at exhibition grounds, $133,000 and 8 warehouses, $66,000.

The report of the city engineer's department at London, Ont., shows the following work carried out during the past year: The sum of $937,202.14 was expended on walks, curbs and gutters, pavements and sewers; eight miles of asphalt pavement were laid, at a cost of $454,931, which meant a saving to the city of about $64,000 as a result of the work having been done by the department instead of letting it out by contract. It is estimated that the city saved $127,120 on all work done this year in the same manner. All work has been suspended except the construction of sewers, which is being proceeded with for the purpose of affording jobs for the unemployed.

Personal

Mr. J. C. Hamilton, water works superintendent of Scarboro Township, Ont., has moved into his new office at Birch Cliff.

Mr. W. H. E. Schmalz, architect of Kitchener, Ont., was the successful contestant in the recent contest for a model and plans of a new city hall for the city.

Mr. H. C. P. Creswell has been appointed superintendent of the Department of Colonization and Development of the Canadian Pacific Railway, at Montreal, succeeding Mr. E. G. White. Mr. Creswell has been with the C. P. R. since 1912, first at Calgary from where he was transferred to Montreal in 1917.

Obituary

Mr. William Scott, assistant superintendent of the Toronto filtration plant, at Centre Island, died at the Weston Sanitarium recently. Deceased was thirty-nine years of age and had occupied the above position for the past three years.

Mr. Thomas Drummond died at his home in Montreal recently, aged 68 years. Deceased was an engineer by profession, having graduated from McGill University, and was interested in mining for several years in Western Canada. He was well known in Montreal sporting circles.

Capt. F. L. Castel, formerly of the engineer's department, Montreal Harbor Commission, died recently in Montreal from pneumonia after an illness of three weeks. Deceased was born in South Africa 66 years ago and was connected with the Harbor Commission in Montreal for fifteen years.

CONSTRUCTIONAL ACTIVITY

Period of December 28 to January 3, 1921

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Cottam, Ont.

Plans will be prepared for drainage system for Gosfield North Twp. Council. W. H. Noble, clerk of Council, Cottam, Ont.

Hamilton, Ont.

Construction of pipe sewer costing $8,000 on Tuxedo Ave., from Main St. to Pipe Line, is contemplated by City Council. E. R. Gray, Engr.

W. A. McLean, Deputy Min., Dept. Pub. Highways, Prov. Govt., Parliament Bldgs., Toronto, will receive tenders until Jan. 20th for grading and construction of waterbound macadam base and other work on Prov. Highway at junction of Caledonia Rd., Barton Twp., and Concession St., Hamilton. Plans with Dept., and office of A. Timmroll, Res. Engr., Simcoe, Ont. Guaranty bond, 50 per cent.

Montreal, Que.

City Council plan construction of sewers on several streets. A. E. Doucet, Engr.

New Westminster, B.C.

City Engr. Stewardson is preparing plans for reconstruction of waterworks to cost $250,000. By-law will be submitted.

City will repair watermains at cost of $10,000. City Engr. Stewardson.

Quebec, Que.

City Council will construct, by day labor, extensions to watermains at cost of $34,000. W. D. Baillairge, Engr.

Renfrew, Ont.

Construction of roads is contemplated by Town Council. By-law will be submitted shortly.

Sydney, N.S.

Council plan alterations and improvements to waterworks to cost $150,000. R. McKinnon, Engr. J. J. Curry, clerk.

City Council will construct sewers in Ashby District by day labor. R. McKinnon, Engr.

Vancouver, B.C.

Plans are being prepared for waterworks extension and water storage estimated to cost $250,000 for City. F. L. Fellowes, City Engr.

By-law will be submitted to ratepayers authorizing sewerage extensions and additions to existing system to cost $250,000. F. L. Fellowes, City Engr.

Westmount, Que.

City Council contemplate improvements to Roslyn Ave.

City Council plan paving on Sherbrooke St.

CONTRACTS AWARDED

Amherstburg, Ont.

General contract for dredging canals and building breakwater at cost of $50,000 at Petromoulx sub-division, river front, for Herrington Realty Co., Detroit, Mich., is awarded to John Handley, Harrow P.O., Ont.

Fredericton, N.B.

Following contracts for construction of standard gravel roads costing $96,000 for Prov. Govt., Dept. Pub. Highways, are: No. 30, Indian Village to Long's Creek, 6.5 miles, Concrete Builders, Ltd., South Devon St., Fredericton; No. 31, Long's Creek to Rosboro, 6.5 miles, Guilford Hammond, Kingsclear, N.B.

Railroads, Bridges and Wharves

Goderich, Ont.

Construction of new sidings in connection with extensions to be made by the Goderich Elevator & Transit Co. is contemplated by G. T. Rly. C. Foorester, Supt., London, Ont.

Hamilton, Ont.

Dominion Power Transportation Co. and City Council contemplate extending car tracks on York St. from present car limit to High Level Bridge. E. R. Gray, Engr.

Montreal, Que.

Plans are being prepared for erection of addition to grain elevator at Windmill Point for G. T. Rly. Jno. S. Metcalf & Co., Ltd., Engrs., 54 St. Francois Xavier St.

St. Francois Xavier, Man.

Ratepayers passed by-law authorizing construction of 2 bridges costing $18,000. C. A. Prefontaine, secy.-treas., St. Francois Xavier.

Toronto, Ont.

H. H. Couzens, Gen. Mgr. Toronto Transportation Cmsn., Ryrie Bldg., will receive tenders until Jan. 9th for fire walls in car barns on Lansdowne Ave. Plans at Room 514 Ryrie Bldg.

CONTRACTS AWARDED

Rosedale, B.C.

General contract for construction of ferry landing for Prov. Govt., Dept. Pub. Works, is awarded to Palmer Bros., 929 Main St.

Public Buildings, Churches and Schools

Arkona, Ont.

Town Council plan erection of Continuation School at cost of $10,000. W. A. Williams, clerk.

Caledonia, Ont.

Erection of school is contemplated by Bd. of Education. Rev. L. O. McKinnon, Chrm.

Dauphin, Man.

Ratepayers passed by-law authorizing expenditure of $150,000 for erection of hospital for Hospital Bd. J. D. Atcheson, architect, Boyd Bldg., Winnipeg.

Daysland, Alta.

Erection of school at cost of $50,000 is contemplated by Daysland School Bd. By-law will be submitted shortly.

Drumheller, Alta.

Ratepayers passed by-law authorizing erection of fire hall. Harold A. Brown, secy.-treas.

Drummondville, Que.

Erection of court house is contemplated by Town Council. W. A. Moisoin, secy.-treas.

Grantham, Ont.

Ratepayers passed by-law authorizing the issue of debentures to the amount of $12,000 for the erection of addition to school for S.S. No. 7, Grantham. Geo. Robinson, secy.-treas., St. Catharines. A. E. Nicholson, architect, 46 Queen St., St. Catharines.

Kingsville, Ont.

Methodist Church Congregation contemplate erecting gymnasium and recreation room at cost of $20,000. Robert Healy, secy.-treas. of Trustee Bd.

Milltown, N.B.

Vaughan & Leonard, 43 Marsh St., St. John, N.B., have roofing and sheet metal contracts for school costing $90,000 for School Bd. Electrical contract is awarded to H. D. Balkneney, Calais, Me.

Montreal, Que.

W. A. Gagnon, architect, 215 Blvd. St. Rose, St. Rose, has prepared sketch plans for auditorium.

Morden, Man.

Ratepayers passed by-law authorizing expenditure of $7,000 for erection of hall. G. McCorquodale, secy.-treas., Morden.

Orillia, Ont.

Plumbing and heating contracts for Memorial Hospital costing $110,000 for Hospital Bd. are awarded to Phillips & Co., 32 Mississaga St. E., and E. A. Latimer, 166 Mississaga St. W.

Renfrew, Ont.

Erection of Collegiate Institute is contemplated by Town Council.

Sabrevois, Que.

Erection of school is contemplated by School Bd. M. S. J. Roy, secy.-treas.

St. Catharines, Ont.

Erection of addition to hospital on Queenston St. is contemplated by Hospital Bd. W. A. Turnbull, secy.-treas.

Sydney, N.S.

F. L. Dixon, architect, Brookland St., is preparing plans for juvenile court and detention home to cost $12,000 for City.

Woodslee, Ont.

Addition to Parish Hall is being erected by R. C. Parish.

CONTRACTS AWARDED

Hamilton, Ont.

General contract at $299,135 for erection of school costing $425,000 on Main St. for Bd. of Education is awarded to P. H. Secord & Sons Construction Co., Ltd., Spectator Bldg.

Contract for tile for sanitorium costing $55,000 for Hamilton Health Assn. is awarded to National Fireproofing Co. of

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Volume of Construction in 1921 Surpassed That in 1920

Construction activity during the year just past surpassed that of 1920 by many millions of dollars. This statement will be borne out by an analysis of statistics printed on another page of this issue, although at first glance, the figures indicate a recession in the value of construction from 1920's high mark. However, in making a comparison on the strength of a dollar and cents valuation of contracts, consideration must be given to the purchasing power of the dollar during the periods under survey. If proper cognizance is taken therefore, of the fact that materials and labor are now lower in price than a year ago, the figures are an indication that 1921 was a year in which the volume of building exceeded that of the previous year.

To be exact, the value of construction contracts awarded in Canada during the calendar year just ended was $240,133,300. compared with $255,605,500, during 1920, a decrease in value of 6.05 per cent. However, as building costs have declined nearly 20 per cent. from the peak which occurred in the fall of 1920 the above figures really imply a greater volume of construction during 1921 than during the year before —roughly, about 20 per cent. more.

The central provinces—Ontario and Quebec—were largely responsible for this showing, as in these two provinces the value of contracts awarded during 1921 exceeds that of the previous year by $5.700,000 and $6,400,000, respectively. If these comparisons are made in terms of the **volume** of construction, instead of the **value,** the splendid achievements of Ontario and Quebec would show up even better. In the West and the Maritimes, construction failed to keep the pace set in 1920 and the low totals in these sections of the country pulled down the aggregate to a point six per cent. below the 1920 value—a value, however, that, as explained, does not mean six per cent. less building but on the contrary, twenty per cent. more.

This statement that activity in the construction industry was a fifth greater in 1921 than in 1920 will come as a surprise to many who have been inclined to view the whole business situation from too pessimistic a viewpoint. In certain branches of the construction business, work has certainly not been plentiful, but these plain figures will vouch for the excellent condition of the industry as a whole. The situation revealed by this analysis should certainly prove a thorn in the side of the blue ruin pessimist, but on the other hand it should give the open-minded contractor a new incentive for the present year and encourage him with the thought that conditions are not always as bad as they seem and that after all, it is not so much a matter of where we stand as of the direction in which we are headed.

Residence Building Increasing; Industrial Building Decreasing

The value of residences built in Canada has advanced in the last few years from 15 per cent. to 32 per cent. of the total value of all construction contracts, while industrial building dropped from 39 to 7 per cent. of the whole. These facts, which are brought out by a study of the statistics printed on another page, afford an interesting insight into the trend of the building industry. This increase in the amount of house construction, together with the tremendous drop in the volume of industrial building shows in which departments the country is underbuilt and in which it is over-supplied. Houses have admittedly been the great need throughout the Dominion—a fact that has given rise to a large number of more or less successful cooperative housing movements in all parts of Canada. The result has been that houses now occupy a more prominent place in the construction industry than they have occupied heretofore. In 1918, they represented only 15 per cent. of the total value of construction carried out in that year, while in 1919, 1920 and 1921, the percentages were 25, 21 and 32 respectively.

This increase in the value of residence contracts has taken place at the sacrifice of industrial building, which has been continually decreasing in volume during the past four years—39 per cent. of the total in 1918, 30 per cent. in 1919, 26 per cent. in 1920 and only 7 per cent. last year. This decrease in factory construction is probably due to the surplus of accommodation that has been prevalent since the war when industrial activity in certain lines demanded tremendous expansion of manufacturing facilities which, with the more recent depression, have been idle or at least only practically employed. However, it was well for the construction industry that the effort usually expended in the industrial field was not wasted but profitably directed into another channel and used to increase the much needed housing accommodation.

It is also interesting to know that the values of business buildings and of engineering structures have been considerably augmented in the past year. The former represented 35 per cent. of the total of new construction, a proportion greater than in any year

No. 72

Canada's Engineers—A. A. Paradis

There is no branch of the engineering profession that carries with it such an opportunity for varied experience or that demands such a great measure of reponsibility as municipal engineering. Indeed, the successful city or town engineer has to exercise, in the course of his everyday work, an acquaintance with a wide variety of problems, not all of which are even engineering, but have to do with finance or other phases of civic administration. In large municipalities where the engineering requirements are departmentalized, engineers may specialize in one or two phases of municipal work, but in the smaller towns or cities where the amount of work is not sufficient to warrant segregation, the municipal engineer must be a man of all-round ability, having at his command a ripe knowledge and experience in many lines of engineering activity. On his shoulders rests a big responsibility and indeed, in many cities, he is the mainspring of municipal success. In recognition of the high place which municipal engineers hold, the Contract Record has, in this series, recorded the achievements of many outstanding Canadian city and town engineers. In this issue we have pleasure in adding another well known name in the person of A. A. Paradis, city engineer of Victoriaville, P. Q.

Mr. Paradis was born in 1883 and was educated in high school and under the direction of a private professor at Montreal. His engineering knowledge is largely a matter of practical experience, for he entered the service of the National Transcontinental Railway in 1904 as rodman and worked his way up through positions of greater responsibility during his ten years connection with that company, from 1907 to 1914 being engineer in charge of construction on that road. Since the latter date he has been consulting and city engineer of Victoriaville, carrying out in this capacity all the engineering activities of that municipality.

Mr. A. A. Paradis

of the past four. The money expended on engineering work was 26 per cent. of the total involved in all construction—also a proportion much in excess of that in 1918, 1919 or 1920. In the latter category, roads are of course, included and considerably augment the amount involved in that division of the construction industry. The high value of business building contracts is somewhat surprising in view of the sentiment of depression that seemed to have been prevalent during the past year. Apparently business was not quite as bad as it seemed and our figures should offer considerable encouragement.

For 1922, we venture to predict that housing will continue to maintain a high place. Although over 16,000 residences were built last year, the country is still very much under-supplied. Considerable activity in the housing line may, therefore, be expected. As far as industrial building is concerned, there is a possibility that there will be more activity this year. At any rate, the fact that it was a small element last year means that the point is drawing nearer when the accommodation available and that demanded will balance and when natural growth will require extended facilities. Business building will show no falling off while engineering work will still continue to absorb a large proportion of constructive effort, inasmuch as roads and municipal improvements are planned to proceed with no abatement.

Mr. J. A. Serre, of Sturgeon Falls, Ont., contractor and dealer in building supplies has erected a store, office and showroom for the display of brick, tile, building paper, roofings and buiders' supplies of all kinds.

Strikes in Building Trades

A deadlock exists between the Toronto Builders' Exchange and the Plasterers' and Plasterers' Laborers' Union and the Sheet Metal Workers' Union, as a result of their inability to agree on the wages to be adopted for the present year. When the agreement between the unions named and the Builders' Exchange expired on December 31, the latter proposed a reduction in the wages which the unions resented. To the plasterers, the Exchange offered 90 cents an hour in place of the $1.00 rate in force last year, for the plasterer's helpers the rate offered was 60 cents instead of 75 cents and for the metal workers, 75 cents in place of 90 cents. The Plasterers' and Plasterers' Laborers' Union are holding out for the old rates and at the time of writing, no settlement had been effected. The Metal Workers' Union offered to compromise at 80 cents, but so far the Sheet Metal section of the Builders' Exchange has refused to hedge from its position. The Builders' Exchange had gone on record as favoring an independent arbitration concerning the question of wages, but the unions have not been inclined to consent. The result is that the employers are considering the adoption of the open shop principle. It is understood that upon the refusal of the employers to accept the Sheet Metal Workers' Union's compromise, this was withdrawn and the union held out for the old rate. About 600 men are involved in the fight. The jobs which are affected are chiefly schools.

The annual meeting of the Associated General Contractors of America is scheduled to take place at Cleveland, Ohio, on January 17, 18 and 19, 1922.

The recently completed bridge over the Batiscan river which is the final link in the Montreal-Quebec highway

Batiscan Bridge Completed—Links up Montreal and Quebec

Seven Span Steel Structure, 1211 ft. Long, was Opened to Traffic on November 1—Construction Details are Described in This Article, Which With Two Articles Previously Published in the Contract Record, Give a Complete Description of the Bridge

By F. B. PAINHAUD

Assistant Chief Engineer, Department of Public Works and Labor, Quebec

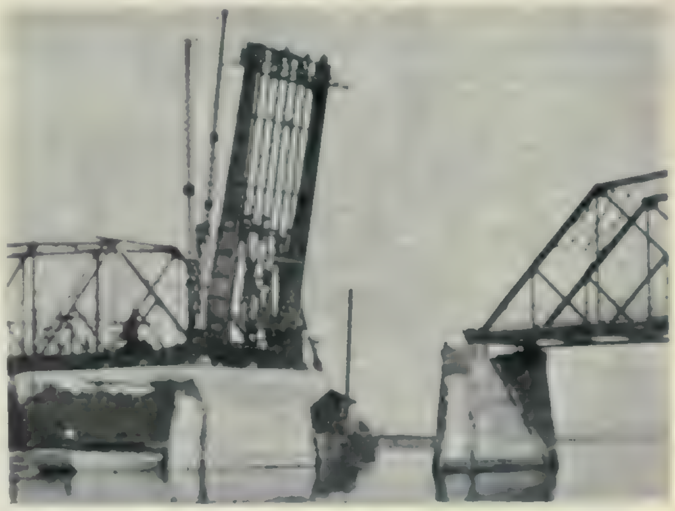
With the completion of the Batiscan River bridge the last link in the Quebec-Montreal automobile road has been closed and motorists have no longer to dread the long delays which so frequently occurred when crossing the Batiscan in the days of the scow-ferry. The first automobile to go over the bridge went across on October 26th, carrying the chief engineer, Ivan E. Vallee, and a few officials, but the bridge was opened to regular traffic only on November 1st.

The gasoline engine which operates the bascule span was not yet in operation at that time so that hand operation which has been provided for cases of emergency had to be resorted to. This mode of operation, however, proved entirely satisfactory and the span was easily opened without putting any additional weight on the counterweight, thus showing that the calculations for the determination of its centre of gravity had been most accurately made. Great credit comes to the MacKinnon Steel Company, Ltd., of Sherbrooke, P. Q., who fabricated and erected the bascule span with machinery complete, and to the Strauss Trunnion Bascule Bridge Co., of Chicago, who designed it and acted as consulting engineers to the Department of Public Works, during its construction.

Construction work on the Batiscan bridge started in the spring of 1920 and was continued through the following winter, which was exceptionally mild, water and aggregate for concrete being heated by steam during cold weather. One of the accompanying photos shows one of the derrick scows frozen in at pier No. 3 and driving steel sheet piling for the cofferdam. Before the spring break-up, channels were cut through the ice and the scows hauled towards the shore.

The bridge consists of six fixed spans and one bascule span over the channel, totaling in length 1211 feet face to face of abutments. The general features of the bridge, and also a detailed description of the substructure and foundation work have been given by the writer in previous issues of the Contract Record, viz., January 21st, and December 22nd, 1920.

Pier for Bascule Span



The bascule span during erection

Pier No. 5, however, is somewhat different from the typical pier already described owing to the fact that it supports the whole weight of the bascule span and all the machinery; its dimensions are, therefore, larger than those of the other piers and it carries at its top a reinforced concrete slab cantilevered on all sides of the shaft. The loadings on the piles for different combinations of dead, live and wind loads were figured with the bascule alternately in open and closed position. The soft clay, which extends down to a great depth, necessitated the use of reinforced concrete spread footings in order to lessen the load on the piles and distribute it over a greater number. One hundred and sixty-six wooden piles were driven in the foundation for this pier inside an enclosure made of 14 in. Lackawanna steel sheet piles penetrating to a depth of 25 ft. 9 in. below the footing. This pier was also designed so as to keep the resultant inside the middle third in the base and very close to it in the shaft. The center of the base was made to almost coincide with the line of action of the resultant of the vertical loads when the action of the wind was not taken into account.

Hauling the girders for the bascule span to the site of the work

The six fixed spans, each 189 ft. 0 in., center to center of bearings, are of the subdivided Pratt type with curved upper chords, or "camel back." The trusses are 30 feet high at center and are set 20 ft. 4 in. apart, providing a clear roadway of 18 ft. 0 in. They are designed for a uniform live load of 83 pounds per square foot uniformly distributed over the whole floor surface or a concentrated load of 30,000 pounds on two axles 10 ft. apart, two thirds of the load being transmitted to the rear axle. They were erected on false work in the usual manner and no special feature deserves mention concerning this part of the work. All joints are riveted and end floor beams are designed for jacking up the spans therefrom in case of future need. One man on the erection force was killed by falling from a scaffold, this being the only casualty during the whole job.

Bascule Span

The bascule span is of the Strauss patent type and was designed, as already stated, by the Strauss Trunnion Bascule Bridge Co., of Chicago. The two half through plate girders, which are 62 ft. 0 in., center to center of bearings, carry a wooden floor and are balanced by a reinforced concrete counterweight. The weight of a man standing on the free end of the span when this has been raised a few feet is sufficient to cause it to move downwards.

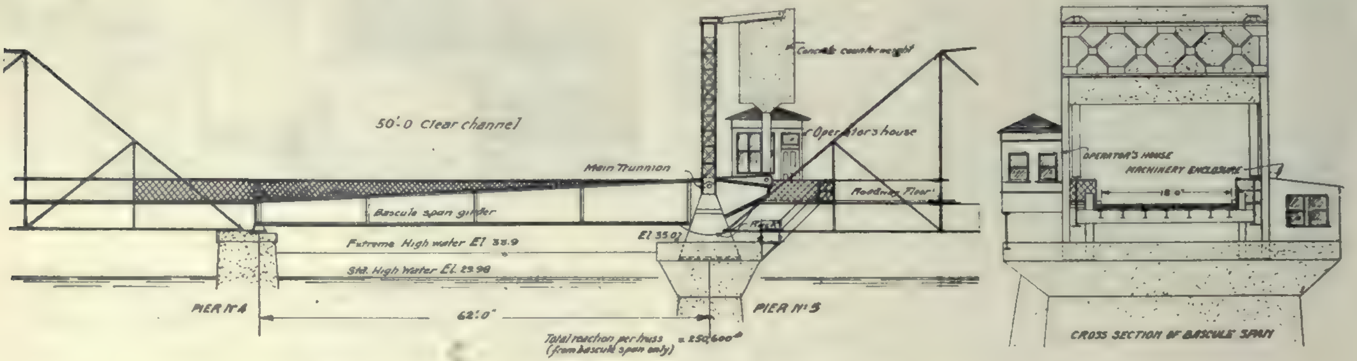
The motive power is furnished by a "Gray" marine gasoline engine, 4 cylinders, 25 h.p., with Stromberg carburetor and Bosch magneto which opens the bascule in about one minute and forty seconds; but it can also, in case of emergency, be operated by hand at lower speed in about six minutes by means of a winch connected by a No. 9 Baldwin chain and sprockets to a small shaft which transfers the motion to the rack of the plate girders through a series of gears and shafts. The machinery is housed in a machinery enclosure lined and covered with corrugated steel fixed to a steel frame. The transmission is of the Fairbanks reversible type. The two main trunnions which bear the girders are 10½ in. in diameter.

Safety Gates

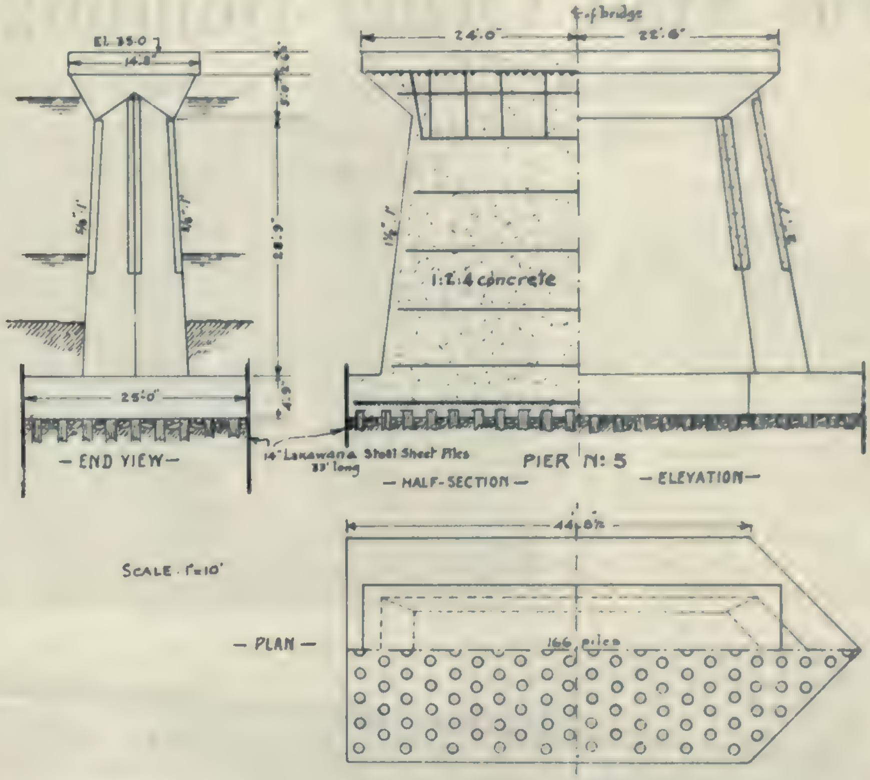
On the two fixed spans adjacent to the bascule span are located steel latticed safety gates which, when swung open, fit alongside the truss over the wheel guard. The one near the operator's house is operated directly by the bridge tender while the other one at the far end is controlled by means of a hand crank and shaft with a specially designed coupling at the free end to allow the shaft to become disconnected when the bridge opens. The upward motion of the span releases a counter-weighted lever which locks the gate in its closed position until the span is lowered back again.

Derrick scow frozen in at the site of pier No. 3

Two lock bars operated by a hand lever located on the web of the upstream girder near the main trunnion fix the bascule span in position when closed to navigation and opened to the traffic. This lever is interlocked with the gate hand crank and so prevents the operator from unlocking the span and setting it



Details of the bascule span on the Batiscan bridge



Details of pier No. 5 which carries the whole weight of the bascule span and the operating machinery. This pier is somewhat larger than the typical pier.

in motion before the safety gate has been closed.

A cable-guyed steel derrick mounted on the end of one of the fix spans held the bascule girders in vertical position during the setting in place of the floor system and machinery and the pouring of the concrete counterweight.

Transfer of the Girders from Cars to Bridge Site

The two girders were transferred from the cars to the bridge site in the following manner: They were set six feet apart, braced together by temporary braces and mounted on two axles with flanged wheels which moved along steel rails. A strong wood post was driven in the ground some distance ahead and a team of horses hitched to a cable passing through blocks supplied the tractive power. When the girders had travelled the distance to the post, this and the rails were re-set ahead and the operation repeated till the water edge was reached, where they were loaded on a scow. The scow was brought alongside Pier No. 5 in the morning and the derrick hoisted them up one at a time and placed them on their bearings so that both were in place before night. The rapidity with which this operation was performed is greatly due to the fact that the center of gravity of each girder had been very accurately located and marked beforehand, so that no time was lost in finding the right place for slinging, and they balanced perfectly well while being lifted up to the top of the pier.

Guide Booms and Anchor Booms

Guide booms are provided on the upstream side of pier No. 5 and downstream side of pier No. 4 for navigation facilities. These are made of four deals 12 in. x 12 in. laid side by side and fastened together by 6 in. x 3 in. cross-pieces and 1 in. diameter steel rods with nut and washer. Each boom is in three lengths, connected by chains and moored at the far end to anchor piers 170 feet distant from the bridge center line. The anchor piers were designed with a view to using part of the 40 ft. Lackawanna sheet piles salvaged from the cofferdams used during the construction of the bridge piers. These sheet piles were driven in the river bed and reach up above ordinary high water level. Inside this enclosure eleven wood piles about 35 feet long were driven and concrete laid through water to a thickness of 4 feet. Loose stones were then piled in up to one foot below the top of the sheet piles and covered with a concrete cap.

This bridge was built under the supervision of Ivan E. Vallee, chief engineer of the Department of Public Works & Labour, and the construction was financed by the government of the Province of Quebec. The contractor for substructure, approaches and reinforced concrete floor was the firm of Jos. Gosselin Ltd., Levis, P.Q. and for the superstructure the MacKinnon Steel Co. Ltd., of Sherbrooke, P. Q. whose chief engineer, Edward Holgate,is largely responsible for the successful engineering of this part of the work. M. L. Guimont was resident engineer for the government and John O'Donnell was the substructure contractor's engineer, having succeeded H. E. Balfour, who resigned. E. Lavigne, of the Department's staff, checked the steel plans and details for the fix spans, while the writer was entrusted with the design of the substructure.

Water Resources of Canada

The Dominion Water Power Branch of the Department of the Interior, Ottawa, are distributing Water Resources Paper, No 29, which deals with the general subject of the surface water supply of Canada. This particular paper covers the Atlantic drainage, south of the St. Lawrence, of New Brunswick, Nova Scotia and Prince Edward Islands. The same department has issued a classified list of reports, numbers 1 to 31.

Eaton Mail Order Building, Winnipeg

Very Large Building Completed in One Year's Time—Special Frost Breaking Machine Speeds Up Construction Work —Details of Design

The latest addition to the many warehouses and stores owned by the T. Eaton Company is the extensive mail order building recently completed in Winnipeg, which can be said to surpass any other building of its kind in Canada, in size, up-to-date methods of construction, and cost.

The building is not of mushroom growth; it is the latest development of the sturdy tree of commerce which took root in Toronto in 1869. Since then the new branches have been stretching in all directions. First, the Toronto store, then factories in Toronto, Hamilton and Montreal; foreign buying offices in Great Britain, France, Switzerland, United States, Japan and other countries; the Toronto mail order house, the Winnipeg store, and the Winnipeg mail order business, now removed to this newest of the Eaton buildings. The company has also mail order distributing warehouses in Saskatoon, and Regina, and a complete mail order business at Moncton, New Brunswick.

June 11th 1921

The new mail order warehouse for the T. Eaton Co., Ltd., at Winnipeg.

The excavation for the Winnipeg building was started early in March 1920, and although there were considerable delays during construction, chiefly due to difficulties experienced in getting delivery of steel and other materials, the work was completed and the building fully occupied for business purposes on the first day of March 1921, the date originally set for completion.

The building is 348 feet, 7 inches long by 121 feet, 2 inches wide. The area of a typical floor, inside the walls, is 40,668 square feet. The total floor area in the building is 442,059 square feet, which makes the total floor area of the company's buildings in Winnipeg to be 1,645,284 square feet or 36¾ acres. The new building comprises 9 storeys averaging over 18 feet in height, and a basement 19 feet high. There is a mezzanine over part of one floor also a driveway and two sets of bridges making two connections at each floor with the previously erected mail order building, shown in photos 1 and 3. Provision is also made on the fourth floor for a steel bridge to span Graham Avenue and connect with the Company's store which occupies the lot opposite the new building and between Graham and Portage Avenues.

The height from street level is about 170 feet. The lower floors are used for packing and shipping purposes, the centre storeys for the storage of merchandise, and the top storeys for the clerical department. The first three storeys are 20 feet high, provision being made in these for future construction of a mezzanine floor. The structural details of the building, and of the adjoining mail order building, are designed with a view to extending the height of each to 12 storeys.

Caissons to Rock

The first two storeys are faced with cut Manitoba Tyndall limestone; above this the facing is Etonia brick with Tyndall stone dressings. The concrete floors are finished with maple except the ground floor and basement which are concrete.

The excavation necessitated the removal of 42,000

A progress view of the Eaton mail order building, Winnipeg, under construction. This warehouse, one of the largest in Canada was erected in a year.

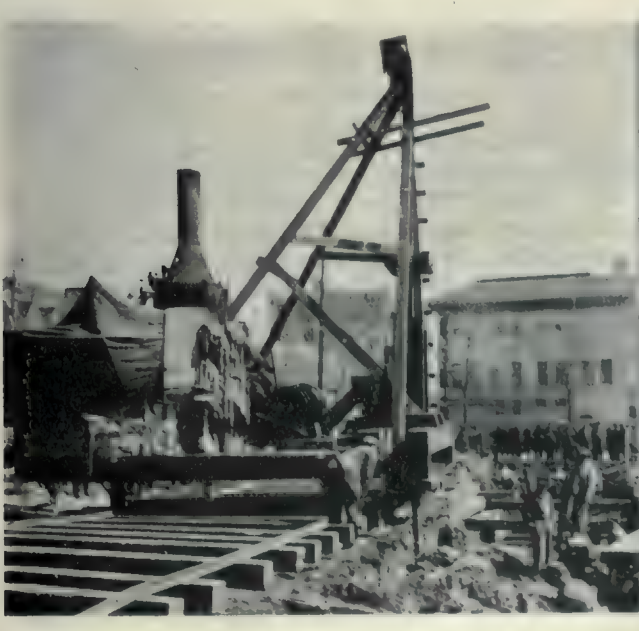
loads of earth, and 3 1/3 million bricks. Approximately 4,500 tons of structural steel, and about 125,000 bags of portland cement were used. An average of 450 men were employed on construction work, at certain times as many as 600 were engaged.

Special Frost Breaking Machine

The early start and the speed with which the excavating was carried out was due to the use of the frost breaking machine, a patent of William Hurst of the Hurst Engineering Company, Winnipeg. By means of this machine excavating can be done throughout the winter in the hardest frozen soil as speedily as by the usual methods during the summer months. In the case of this building the foundation soil is stiff clay which, at the time of beginning operations, was frozen as hard as solid rock to a depth of from six to eight feet. The frost machine sheared this off in lumps of convenient size for loading into the wagons without the least trouble.

The new building is fitted with a sprinkler system containing 4,500 sprinkler heads. There are four combination passenger and light freight elevators, and two large freight elevators. There is a hospital about 20 feet by 30 feet on the second floor and adequate toilet accommodation on every floor.

The cost of the completed building is about $3,000,000. Graham, Anderson, Trobst and White, of Toronto were the architects. Peter Lyall & Sons Construction Co. Ltd. were the general contractors, while sub-contractors were as follows: Cotter Bros., plumbing and heating; Star Electric Co., electrical work; Dominion Bridge Co., structural steel; Otis-Fensom Co., elevators; Fulcan Iron Works, ornamental ironwork; Taylor Decorating Co., painting; Western Plastering Co., plaster work; Grinnell Co., of Canada, sprinkling system; McFarlane Douglas Co., roofing and metal work. All except the last two are Winnipeg companies.



Special machine for breaking up frozen clay.

Excavation showing in background 2 clay breaking machines.

Concreting in Freezing Weather

Some Precautions that Practical Experience has Determined as Necessary for Successful Construction During the Winter Season

By the Turner Construction Company, New York

Although a few years ago it was considered bad practice by engineers and unprofitable for contractors to continue concrete construction throughout the winter months, such procedure is now becoming common practice by the most successful contractors. It enables them to maintain a competent year-round organization, to take advantage of our low winter prices and of the large supply of labor. It also enables the owner to occupy the building three or four months earlier than would be possible if construction stopped during the winter months.

It has been long recognized that low temperature retard the hardening of concrete and that extreme cold prevents it altogether. Realizing these facts and at the same time appreciating the many advantages of working through the winter, the Turner Construction Company of New York City cites a series of experiments made in the laboratory of the University of Illinois and published in the proceedings of the American Concrete Institute, to determine more definitely what effects low temperatures had on the rate at which concrete hardens.

Nine test cubes of 1: 2: 4 pebble concrete were subjected to the following tests:

The first three cubes after being stored in a temperature of 60 degrees Fahrenheit for five days, were subjected to compression tests. They had developed an average strength of 917 pounds per square inch. This is about normal strength for concrete five days old.

The second three cubes were stored at a temperature of 60 degrees for five days and for fourteen days more at a temperature below freezing and then tested. The result showed an average compressive strength of 1042 pounds per square inch or a gain of only 125 pounds in 14 days.

The remaining three cubes were stored at 60 degrees Fahrenheit for five days and for 28 days more at a temperature below freezing and then tested. The result showed an average strength of 1063 pounds per square inch or a gain of only 146 pounds in 28 days. We should ordinarily expect test cubes stored in a temperature of 60 degrees F. or over for 33 days to show a strength of at least 2000 pounds per squre inch.

These tests prove without question that there is a considerable retardation of rate of hardening at low temperatures and that concrete gains strength very slowly in cold weather even when first allowed to set for five days at a temperature of 60 degrees F.

Further tests were made with 1: 2: 4 pebble concrete cubes which were stored for three months at a temperature below freezing. They were then all removed and stored at a temperature of 70 degrees F. After storage for seven days at this temperature, some of these cubes were tested and showed no appreciable strength. Others were tested after a period of one month's storage at 70 degrees F. and showed an average strength of 703 pounds per square inch when we should expect a strength of at least 2000 pounds per square inch from normal 1: 2: 4 concrete.

The test shows the positive necessity of immediately protecting concrete as soon as it is placed and that concrete once frozen and then thawed out gains strength very slowly:

Necessary Precautions in Winter Weather

The foregoing facts lead to the following important conclusions: First; that concrete must be kept from freezing and must be kept warm for a period of four or five days before exposing to cold and that after setting at warm temperature for five days it gains strength very slowly when exposed to cold temperatures. Second; that as the concrete is still weak in compression when forms are removed, special care must be used to prevent excessive stresses while stripping and in depositing. Work started in the fall of the year or before spring or at such time that concrete must be placed in a temperature below freezing, should be considered winter weather work and should be protected accordingly.

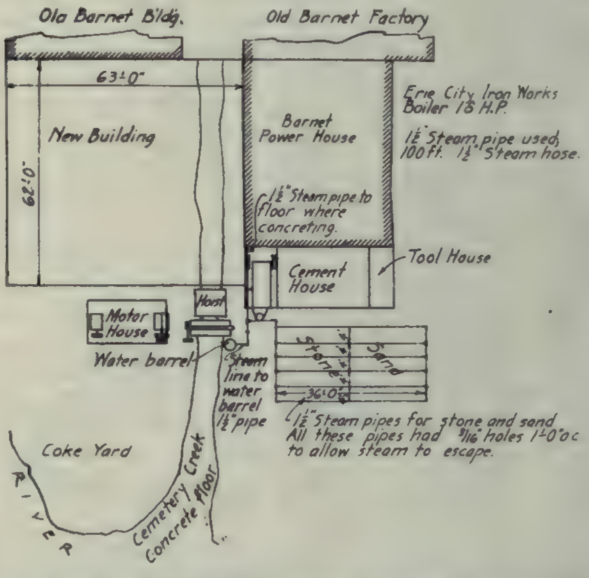

Old Barnet B'ldg.
Old Barnet Factory
63'-0"
62'-0"
New Building
Barnet Power House
Erie City Iron Works Boiler 15 H.P.
1½" Steam pipe used, 100 ft. 1½" Steam hose.
1½" Steam pipe to floor where concreting.
Tool House
Cement House
Hoist
Motor House
Water barrel
Steam line to water barrel 1½" pipe
Stone
Sand
36'-0"
1½" Steam pipes for stone and sand All these pipes had 5/16" holes 1'-0" o c to allow steam to escape.
Coke Yard
River
Cemetery Creek
Concrete floor

Fig 1—A grillage of steam pipes is a most satisfactory method of heating aggregates

For certain work such as footings, the roof of a building, or if the work will continue for only a short time in moderately cold weather, only partial protection may be sufficient. Partial protection has been satisfactorily provided by heating the sand and pebbles over pipes inside of which fires are kept burning. After placing, the concrete may be covered with one-ply tar paper, which in turn is covered with marsh hay, manure or canvas. In any case, the frost must be removed from the aggregates and covering applied to retain both the heat supplied and that generated in the process of hardening.

When concrete must be placed in severe or protracted cold weather it will be necessary to provide sufficient canvas, salamanders and fuel for its protection. Lumber must be provided for frames and a boiler with sufficient steam hose, perforated pipe, etc., will be necessary to provide steam for heating materials.

Methods of Heating Materials

The experience of the Turner Construction Co. has shown that for complete protection the most satisfactory method is to heat the aggregate and water with steam, cover the green concrete with tight canvas and place salamanders so as to cause circulation of heat around the concrete.

Before starting to mix the concrete, the superintendent should be positive that all aggregate is from 35 to 50 degrees F. The mixing water should be at a temperature of 100 to 150 degrees F.

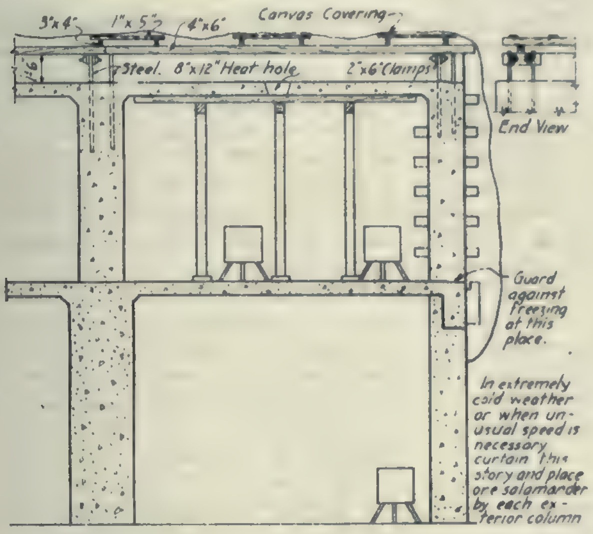

3"x4"
1"x5"
4"x6"
Canvas Covering
1'-6
Steel. 8"x12" Heat hole
2"x6" Clamps
End View
Guard against freezing at this place.
In extremely cold weather or when unusual speed is necessary curtain this story and place one salamander by each exterior column

Fig. 2—Protection of concrete against frost action by canvas curtains

It has been found that a grillage of steam pipes is the most satisfactory method of heating sand, and pebbles. A 1½-inch steam line is run from the boiler to the location of gravel and sand storage from which a grillage of 1½-inch pipes should be laid on the ground covering an area slightly smaller than the area to be covered by the storage pile. These pipes should be 4 feet on centre and should be perforated with 3/16-inch or ¼-inch holes staggered on 1 foot 6 inch centres (see fig 1). Some trouble has been experienced with large grains of sand blocking up round holes and this may be avoided by cutting notches in the pipe with a hack saw at intervals of 1 foot or 1 foot 6 inches. If the sand and gravel is stored in bins a grillage of steam pipes should be provided in the bottom of the bins.

In case the pile of material will not be constant enough to warrant a grillage on the ground insert three connections in the steam main controlled by valves and attach to each connection a length of steam hose on the end of which attach a 6-foot length of perforated pipe. This pipe should have one end closed and drawn to a point. Two of these perforated pipes should be driven into the gravel pile and one into the sand pile at the places where the carryalls are being loaded. A 1½-inch steam line controlled by valve conveniently placed at the mixer should be run from the boiler to the water barrel with the pipe extending down into the barrel to about 2 inches from the bottom in order to force live steam into the water. A 1½-inch line should be run up the concrete hoist and a suitable valve and connection supplied at each floor level to provide for the attachment of steam hose for cleansing ice and snow from the forms and reinforcement.

Size of Boiler

For a large sized operation a 50 h.p. boiler carrying from 50 to 60 pounds of steam is required to furnish heat and if steam is used for cleaning snow and ice from the forms in addition to heating aggregates and gauging water, a 50 h.p. boiler is the smallest practicable size for even a comparatively small job. However, on small jobs having not more than 5,000 feet floor area on one floor an 18 to 25 h.p. boiler will give good results.

All ice and snow accumulated in the forms or on the steel must be removed before concrete is placed and special care must be taken to remove any snow or debris in the bottom of the forms. Live steam should be run into the forms continuously ahead of the concrete to remove frost from the steel and every precaution must be taken to prevent the condensed steam from forming into ice again. Where a considerable area of steel is placed in advance of concreting, it is advisable to throw canvas covers over it at night to guard against snow falling into the forms under the steel.

Concrete of a stiff jelly-like consistency will gain strength more quickly than a wet mix and less trouble will be experienced with laitance. For this reason concrete placed in winter weather should be mixed with only enough water to permit proper deposition in the forms. The concrete should be placed in the forms at a temperature of not less than 50 degrees F. When concreting at moderate temperatures scarcely below freezing, and when only partial protection is needed, the concrete need not go into the forms at such a high temperature but absolute certainty must be had that the temperature of the mixer is always well above freezing and that the aggregate is absolutely free from frost.

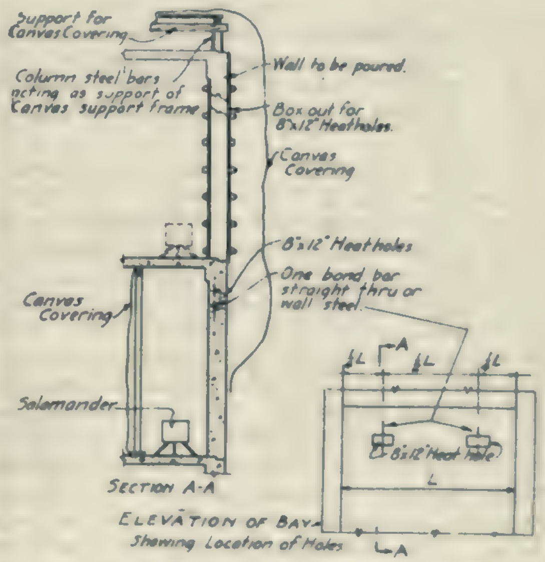

Support for Canvas Covering
Column steel bars acting as support of Canvas support frame
Wall to be poured.
Box out for 8"x12" Heatholes.
Canvas Covering
8"x12" Heatholes
One bond bar straight thru or wall steel.
Canvas Covering
Salamander
Section A-A
Elevation of Bay Showing Location of Holes
L
A
A
8"x12" Heat hole

Fig. 3—Method of protecting exterior columns

The canvas used for covering should be lapped adequately and fastened together so as to be as nearly weatherproof as possible. A good practice is to support the canvas on wooden forms resting on the column reinforcement at about 18 inches above the finished concrete floor surface and hang canvas curtains from the exterior columns or the floor to be concreted. The curtains should be carefully lashed to the under side of the floor below, care being taken to have the canvas some distance from the exterior forms so as to provide a circulation of heat (see Fig. 2). Then a curtain hung across the width of the building under the forms will shut off the section to be concreted. Enough salamanders should be provided to maintain a temperature of from 60 to 80 degrees in this section. This will usually require one salamander to every 300 feet of floor area The side curtains should be in place and fires started in the salamanders as soon or before concreting is started and in extremely cold weather the curtains should be in place and fires burning for several hours before beginning to deposit concrete. As soon as one bay of the slab is concreted it should be immediately covered and in general, the entire work should be closely followed with the protection. Where the bays are not over 20 feet square provide one heat-hole about 8 by 12 inches through the slab so that circulation of heat may be maintained all over the slab. In larger bays, provide a heat-hole for about each 300 feet of floor area. These heat-holes should have bevelled sides so as to make the filling plug of concrete perfectly secure, (see Fig. 2 When the canvas is removed the heat-holes should be covered with boards.

Columns Poured With Floor

It is best practice in winter work to concrete the columns the same time as the floor and in this case great care should be taken to tamp the columns to prevent shrinkage cracks between slab and column head. Tamping sticks should be left in the head of the column and for several hours after the floor is concreted, tamping of the columns should be continued. If the columns are concreted the day previous to the floor slab the side protection should be in place, floor forms made tight and the tops of the columns covered to prevent the concrete in the column heads from freezing.

One of the most difficult places to protect from frost is the base of exterior columns. It is frequently found that with a temperature of 80 degrees near the under side of the slab, a temperature below freezing will be found near the base of the external columns. Hence, in extremely cold weather it is necessary to place a salamander on two sides of every external column. The bottoms of the columns may be further protected by packing the forms with marsh hay or other suitable material. When unusual speed is required or in extremely cold weather it will be necessary to curtain the floor below and place salamanders around the bases of external columns. By this means the bases of the finished columns will be supplied with heat. This method of protection is also necessary when monolithic walls are carried up with the building as it is practically impossible to protect them from the cold unless heat is supplied from the storey below. If the walls are blank it will be necessary to provide openings in the forms to allow circulation of heat to the outside of exterior walls. These openings should be about 8 by 12 inches and should be bevelled down and upwards so as to prevent water from entering the building when holes are plugged, (see Fig. 3). There should be two such heat openings in each panel between columns.

Proper Firing of Salamanders

It is important that the man tending the salamanders be carefully instructed as to the proper method of firing and as to the precautions necessary to prevent the canvas and forms from catching fire. Best results in firing will be accomplished if a small amount of fuel is applied frequently thus obtaining a maximum of heat with a minimum of smoke. The average laborer has a tendency to apply a large quantity of fuel at infrequent intervals as this tends to lighten his work.

As a protection against fire several barrels of water should always be standing on each floor where salamanders are burning. They should be inspected frequently to see that the water has not leaked out or frozen. Care must be used to see that the canvas is securely fastened in order to prevent it from blowing against the salamanders as experience has shown that this is the greatest fire hazard and source of danger from fire.

During the entire time that protection of concrete is in progress a detailed temperature record should be kept in permanent form showing the date and hour, outside temperature, temperature at bottom of columns, temperature at under side of the slab, under the canvas over the slab, and the temperature of the concrete as it is placed in the forms. Temperatures should be taken at the bottom of a number of exterior columns and especially those columns on the windward side of the building.

The superintendent in charge of winter construction work should make a personal inspection of the the precautions are being carried out. He should also make occasional visits to the work in the course of the night in order to see that all the men are carrying out their various duties.

Removal of Forms

The following is the practice of the Turner Construction Company in regard to the removal of forms: The top canvas shall not be removed before the end of the second day or before at least 48 hours after the concrete is in place. At this time the exterior columns may also be stripped. To do this, it will be necessary to loosen the side curtains for at least a short period but the operation of stripping should be carried on as quickly as possible and the side curtains carefully replaced so as not to lose the heat from under the slab. The side curtains should not be removed before the end of 4 days or at least 96 hours after the concrete is in place. At this time the curtains may be stripped and on the following day the remainder of the forms may be taken off.

For flat construction the top canvas should not be removed before the end of the third day or before the concrete has been protected in place for at least 72 hours. The exterior columns may also be stripped at this time taking care to replace the canvas as soon as possible. The side canvas should not be removed before the end of the fifth day or 120 hours after the concrete is in place and protected. At this time the floor forms may also be stripped.

Because of the speed of erection of multi-storied buildings, the dead load of the storey above is often added when the concrete of the lower storey is from 7 to 14 days old and which has been protected from the cold only 5 days. We know that, from the experiments described, such concrete has only a fraction of its ultimate strength. This is particularly important in buildings of the flat slab design where the upper part of the slab has to take compression. Therefore, the importance of having the upper part of the slab well hardened before any forms are removed is readily seen. In beam and girder construction this weakness is not so marked as three sides of each beam and girder are exposed to the heat under the forms and therefore, porbably gain strength more rapidly than the surface of the flat slab.

Construction Developments During December

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction activity in Canada, according to figures compiled by MacLean Building Reports, Limited, during the month of December, amounted to $19,118,500. This is the second largest December total on record, being exceeded only once, and that in December, 1912, when $31,125,528 was expended. The figures for the different provinces are as follows:—

Ontario, 732 projects valued at $8,959,900; British Columbia 147 projects valued at $5,197,000; Quebec, 187 projects valued at $2,995,900; New Brunswick, 13 projects valued at $1,147,500; Manitoba, 17 projects valued at $342,600; Nova Scotia, 36 projects valued at $198,600; Alberta, 13 projects valued at $139,500; Saskatchewan, 15 projects valued at $137,500; total for Dominion, 1160 projects valued at $19,118,500.

Work reported during December for the first time as contemplated totalled $13,997,800 The figures for the Dominion are as follows:—

Ontario, 251 projects valued at $8,790,700; Quebec, 265 projects valued at $2,627,000; Western Provinces, 51 projects valued at $2,124,100; Maritime Provinces, 16 projects valued at $456,000; Total for Dominion, 583 projects valued at $13,997,800.

Building Activity Encouraging

The value of construction contracts awarded throughout Canada during 1921 was $240,133,300, compared with $255,605,500 in 1920; $190,028,300 in 1919, and $99,842,100 in 1918. However, if price recessions in material and labor costs are taken into consideration, the volume of new construction undertaken during 1921 was many millions of dollars greater than the 1920 total.

Now on the Up-grade

Canada has undoubtedly passed the worst stages of depression and is now on the up-grade according to MacLean Building

Construction Contracts Awarded in Eastern Canada, December, 1921

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	5	$ 110,000	2	$ 67,500	....		....		7	$ 177,500
Churches	3	238,000	2	90,000	....		....		5	328,000
Factories	3	49,000	4	42,000	....		....		7	91,000
Public Garages	6	194,800	7	34,500	1	$ 75,000	3	$ 40,500	17	344,800
Hospitals	1	450,000	....		....		....		1	450,000
Hotels and Clubs	7	107,000	....		....		1	13,500	8	120,500
Office Buildings	3	547,000	1	60,000	....		....		4	607,000
Public Buildings	2	20,700	....		....		....		2	20,700
Residences	627	2,858,300	147	826,600	9	34,500	29	129,600	812	3,849,000
Schools	3	615,100	1	4,500	....		1	8,000	5	627,600
Stores	39	717,000	12	76,100	1	3,000	2	7,000	54	803,100
Warehouses	5	402,800	5	109,000	....		....		10	511,800
Total Buildings	704	$6,309,700	181	$1,310,500	11	$112,500	36	$198,600	932	$7,931,200
Dams and Wharves	2	$ 104,500	....		....		....		2	$ 104,500
Sewers & Waterm'ns	12	427,600	5	$ 105,400	....		....		17	533,000
Roads and Streets	3	28,100	....		....		....		3	28,100
General Engineering	11	2,090,000	1	1,580,000	2	1,035,000	....		14	4,705,000
Grand Total	732	$8,959,900	187	$2,995,900	13	$1,147,500	36	$198,600	968	$13,301,900

Construction Contracts Awarded in Western Canada, December, 1921

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	1	$ 7,500	....	$..........	....	$..........	....	$	1	$ 7,500
Churches	1	4,000	....		....		....		1	4,000
Factories	1	22,000	1	100,000	1	60,000	2	201,100	5	383,100
Public Garages	....		....		1	10,000	1	5,500	2	15,500
Hospitals	1	2,800	....		1	2,500	....		2	5,300
Hotels and Clubs	2	270,000	....		1	1,500	....		3	271,500
Office Buildings	....		1	3,000	....		2	61,000	3	64,000
Public Buildings	1	32,900	1	1,900	....		....		2	34,800
Residences	101	382,200	6	23,300	6	21,500	8	25,000	121	452,000
Schools	4	41,000	2	4,300	1	6,000	....		7	51,300
Stores	17	91,800	2	7,000	2	4,000	4	50,000	25	152,800
Warehouses	1	3,000	....		....		....		1	3,000
Total Buildings	130	$ 857,200	13	$139,500	13	$105,500	17	$342,600	173	$1,444,800
Bridges	3	$ 46,000	....	$..........	....	$	....	$	3	$ 46,000
Dams and Wharves	5	86,000	....		1	1,100	....		6	87,100
Sewers & Waterm'ns	5	105,800	....		....		....		5	105,800
Roads and Streets	....		....		1	30,900	....		1	30,900
General Engineering	4	4,102,000	....		....		....		4	4,102,000
Grand Total	147	$5,197,000	13	$139,500	15	$137,500	17	$342,600	192	$5,816,600

Contemplated New Construction Work in Canada, December, 1921

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	3	$ 303,500	2	$305,000	....	$..........	2	$ 25,000	12	$ 633,500
Churches	4	205,000	2	120,000	....		2	15,000	8	340,000
Factories	16	866,200	4	242,000	3	58,000	3	190,000	26	1,356,200
Public Garages	4	44,000	2	40,000	1	10,000	....		7	94,000
Hospitals	2	40,000	....		1	30,000	....		3	70,000
Hotels and Clubs	9	2,130,000	2	16,000	1	40,000	6	88,500	18	2,274,500
Office Buildings	4	1,125,000	2	100,000	1	15,000	2	205,000	9	1,445,000
Public Buildings	13	719,000	....		....		3	21,000	16	740,000
Residences	117	704,000	223	1,228,000	4	32,000	10	60,000	354	2,024,000
Schools	12	966,000	8	100,000	3	205,000	8	550,100	26	1,821,100
Stores	12	219,000	10	133,000	1	6,000	4	60,500	27	418,500
Warehouses	8	122,000	3	95,000	....		....		11	217,000
Total Buildings	204	$7,443,700	258	$2,379,000	15	$396,000	40	$1,215,100	517	$11,433,800
Bridges	....	$..........	3	$ 70,000	....	$..........	1	$100,000	4	$ 170,000
Dams and Wharves	2	130,000	1	50,000	....		4	54,000	7	234,000
Sewers & Waterm'ns	20	391,000	2	28,000	....		1	30,000	23	449,000
Roads and Streets	14	185,000	1	100,000	1	60,000	....		16	345,000
General Engineering	11	641,000	....		....		5	725,000	16	1,366,000
Grand Total	251	$8,790,700	265	$2,627,000	16	$456,000	51	$2,124,100	583	$13,997,800

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
December, 1921	$ 8,959,900	$ 2,995,900	$ 1,346,100	$ 5,816,600	$ 19,118,500
December, 1920	1,986,300	4,435,600	393,200	1,931,400	8,746,500
December, 1919	4,849,300	1,932,600	648,700	1,258,800	8,689,400
December, 1918	1,402,100	480,800	325,200	3,071,800	5,279,900
12 months, 1921	113,855,000	61,337,500	9,288,900	55,651,900	240,133,300
12 months, 1920	108,120,800	54,904,600	21,395,000	71,185,100	255,605,500
12 months, 1919	87,356,800	55,277,800	18,772,600	28,621,100	190,028,300
12 months, 1918	33,385,200	23,641,700	23,180,300	19,634,900	99,842,100
According to Classification or Types	**Residential**	**Business**	**Industrial**	**Engineering**	**Total**
December, 1921	$ 4,486,000	$ 4,416,000	$ 474,100	$ 9,742,400	$ 19,118,500
December, 1920	1,522,400	2,829,100	344,700	4,050,300	8,746,500
December, 1919	2,625,000	3,302,200	2,457,200	305,000	8,689,400
December, 1918	547,200	2,165,300	1,362,800	1,204,600	5,279,900
12 months, 1921	76,655,400	84,721,700	16,503,700	62,252,500	240,133,300
12 months, 1920	54,891,100	86,073,200	64,625,900	50,015,300	255,605,500
12 months, 1919	47,015,100	59,606,400	57,091,300	26,315,500	190,028,300
12 months, 1918	14,661,800	26,196,800	38,975,200	20,008,300	99,842,100

CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY TO DECEMBER (INCLUSIVE), 1921

	Ontario		Quebec		Maritime		Western	
	No.	Value	No.	Value	No.	Value	No.	Value
Residential Buildings	9451	$44,565,200	3147	$17,093,200	505	$2,394,000	3180	$12,603,000
Business Buildings	1290	37,057,000	713	28,517,200	176	3,478,600	1045	15,668,900
Industrial Buildings	109	6,210,300	66	3,189,000	11	300,000	55	6,804,400
Public Works and Utilities	487	26,022,500	282	12,538,100	74	3,116,300	293	20,575,600

Reports, Ltd. Activities in the construction industry are sign-posts of conditions throughout the country. During the last four months this industry has revealed extremely encouraging indications. Knowing that the costs of building at the present time have been considerably reduced, those who have for some months intended building are asking for new tenders on their proposed work. Building contractors and builders' supply people are making a special effort to reduce prices to a minimum, to restore this important key industry to its wonted pre-war proportions.

Builders' Exchanges of Quebec Organize on Provincial Basis

The proposed Provincial Association of Builders' Exchanges of Quebec, is well on the way to realization, according to D. K. Trotter, secretary of the Montreal Builders' Exchange, who has been very active in pushing forward the proposed organization.

The new association will press for various changes in the law of the province, one of the most important changes asked for being in the law which makes builder and architect jointly responsible for the safety of any building they erect. This, it is claimed, gives an unfair advantage to the foreign contractor who can easily assume all these liabilities, knowing that he will be outside the jurisdiction of the Quebec courts soon after the contract is concluded.

It is expected that the first general and annual meeting of the new association will take place at Quebec as early as possible to synchronize with the opening of the Provincial Legislature when their plans for improving legislation regarding the building laws of the Province will be impreessed upon the government.

Mr. Trotter stated that the idea of the new organization was to include, not only organized bodies of those engaged in the building industry where organizations already existed, but also to bring in individuals engaged in the building trade in cities and towns of the Province where at present there are no organizations. This includes such places as Three Rivers, Sorel, Ste. Hyacinthe, and others of the smaller municipalities.

At the present time there are only three associations in the province of Quebec interested in the building trade, the Builders' Exchanges of Montreal, Quebec and Sherbrooke.

Mr. Trotter was at Three Rivers, organizing for the provincial work, and the support he received from the contractors and dealers in building supplies was greater than he expected. As the result of his visit it is expected that there will be an influential delegation from Three Rivers at the Quebec organization meeting.

The constitution and by-laws of the new provincial organization have been tentatively agreed to. The first business before the meeting at Quebec will be to agree to the definite adoption of these rules for the new provincial organization.

It is expected that there will be about 80 delegates at the meeting. The first business will be the adoption of the constitution and by-laws, and the election of the first officers of the association.

Will Meet Government

The association will plan to make representation to the provincial government on the following points:—The builders' liability in Quebec Province, the Workmen's Compensation Act, and the desirability of calling for tenders for all works undertaken by the province through the medium of the press.

Mr. Trotter states that it has long been a grievance that the builder and architect in this province had been in the unique position of being jointly responsible for the safety of buildings constructed and designed by them during a period of 20 years after completion.

This law prevails in no other Canadian province, and, so far as the Builders Exchange can learn, in not any one of the United States. In most of these provinces and states a clause is embodied in the contract setting forth the time during which the architect and contractor should be held responsible. The great objection to the Quebec law says Mr. Trotter, was that it enables contractors from other countries to undertake work there, assuming all legal liabilities, while within a short time after the completion of their contracts they might be outside the jurisdiction of the Quebec courts.

It is expected that the organization meeting of the Provincial Builders' Association will make representations to the Quebec government asking that the present law in this regard be made more in accord with the practices of the rest of the continent.

Another matter to be urged before the provincial government is that tenders for all works be called for in the most public manner possible, by advertisment in the press and otherwise, this being specially demanded by the Montreal Builders' Exchange.

"As a result of this wider organization," says Mr. Trotter, "the Provincial organization of Builders' Exchanges will be able in future to co-operate with the provincial minister of public works and labor, to assist him in any legislation affecting the interests of the building industries of the province. We hope to make a strong organization, and to give the government liberal and effective support in any legislation regarding the building industry, which probably will be one of the outstanding industries during the next few years.

Next Week's Construction Conference to Establish Confidence

Some of the foremost men in Canada who are interested in the construction industry, and who have been giving serious thought to these problems, will meet at the Royal Connaught Hotel, Hamilton, at the Fourth Annual Conference of the Association of Canadian Building and Construction Industries, January 17th to 20th. There will be representatives of some of the largest manufacturing concerns and suppliers of building and construction material, as well as prominent general contractors and sub-contractors. They are gathering, not merely for selfish reasons, but because they believe that one of the best ways to start a general revival of industry in Canada is to get the building public to feel that the time is right for investment in new homes, schools and public buildings, for which there is such a need. It is a well-known fact that when construction starts, a great impetus is given to a large number of other industries, and construction has therefore been termed one of the "key" industries. When a new house is built, a demand is at once created for hardware, electric fixtures, carpets, bedding, linens, linoleums and furniture. Money is placed in circulation, not alone in the wages of the mechanics employed on the structure, but also in the hundred and one factories producing the finished articles from the raw product, as well as in the forest and mine. Construction materials also figure as one of the large factors in the freights carried by our railways and shipping concerns.

It is interesting to note, therefore, that in the preparation of the programme for this conference at Hamilton, special attention has been given to provide time for the full discussion of such questions. On the opening day, Tuesday, January 17th, there is not only an open business session, at which suggestions will be received from members, but there will also be a session of the National Council, and in the evening, meetings of the sections, viz., manufacturing and supply, general contractors, and trade contractors. At these section meetings, each group discusses the questions which are brought before it, from its own particular angle, and then makes suitable recommendations to the general session.

Wednesday, January 18th, has been called visitors' day, and a special invitation is given the general public, and architects and others interested in construction, to come in and see the exhibit which is being presented by various large manufacturing and supply firms. This exhibit will comprise products used in building work, and also some of the most up-to-date methods will be illustrated. Motion pictures will be thrown on the screen, showing some of the newest types of machinery.

The speakers scheduled for this and the succeeding days of the conference are to deal with subjects of a most practical nature. It is expected that one of Mr. Roger Babson's specialists, who has made a study of construction problems, will be present and speak on "The Outlook for 1922." The Aberthaw Construction Company, who have made an exhaustive study of cost accounting and estimating, have promised the services of one of their experts, Mr. Connor, and possibly also Mr. Thayer, to discuss these phases of the troubles of contracting. Mr. J. Groves Smith, Dominion Fire Commissioner, will deal with the relation of fire prevention work to construction in Canada. Mr. Wormith, of the Workmen's Compensation Board of Ontario, will speak of the administration of the Compensation Act in that province, and compare it with the acts in force in the other provinces of the Dominion. The relation of freight rates to the heavy commodities, such as brick, lumber, cement, and lime, will be the subject of a discussion led by W. J. Nicholson, and F. B. McFarren, of Toronto. Mr. Hall, of the Canadian Surety Company, is to give an address on "Building Bonds," and Mr. Whittemore, of "MacLean's Building Reports" will illustrate his talk on "The Canadian Situation in the Year 1922" by specially prepared charts, showing costs and permits for several years.

The social side of the conference will also be provided for adequately. Each day a luncheon is held, at which the Hamilton Association is responsible for furnishing speakers. The evening of Wednesday 18th is left free for the delegates to attend the hockey match between St. Patricks and Hamilton, at the Hamilton Arena, while the afternoon of the following day is to be devoted to an inspection of the bascule bridge, Burlington canal, at the invitation of the Hamilton Bridge Works, and to the visiting of some of the factories for which Hamilton is famous.

There is a growing feeling of optimism as to the future in the building and construction industry, and it is expected that the work of this conference will do a great deal to establish the necessary confidence which will ensure an increasingly steady growth in the various branches of building and construction activity during the year 1922.

Curbing Building Labor Tyranny

As a Result of the Lockwood Inquiry, the Counsel for the Committee Orders Elimination of Vicious and Illegal Practices—Employers to be Protected Against Abuses

As a result of the disclosures of the criminal activities of the unions of the building trades at the Lockwood investigation in New York, the counsel for the Lockwood Commission, Mr. Samuel Untermyer, has drawn up a series of demands that will curb labor tyranny and protect employers against the extortionate abuses of the unions. In his analysis of the disclosures, Mr. Untermyer does not mince words in his denunciation of some of the methods employed by labor organizations in their dealings with architects and constructors. He characterizes many of the so-called labor regulations as thoroughly vicious and illegal.

Mr. Untermyer's demands are as follows:

1—All restrictions on membership must be removed. Books must be at all times open for admission of members who qualify on reasonable character and capacity regulations.

2—Initiation dues shall in no case exceed $50. They should be payable at the option of new members half cash, remainder within three months.

3—All limitations on the number of apprentices must be repealed. Where age limits exist in any constitution or by-law it should be increased from the prevailing age rule, sixteen to eighteen, to the age of twenty-five.

4—Issuance of permit cards to non-union men with or without pay to the union as a condition of allowing such men to work with union men, or for any other real or ostensible reason, must be rigidly forbidden by constitutional amendment.

5—In order to protect members of unions against misappropriation of funds and insure accountability of officials, constitutions should be amended where necessary to require accurate accounts to be kept showing all receipts and disbursements. All payments over $10 must be made by check. Accounts shall be audited semi-annualy. Every member shall be entitled to examine the accounts. A copy of the detailed semi-annual report to be mailed to every member.

Protection of Employers

6—It must be made plain by amendments that the unions do not possess the power some now assume to hale employers before them and compel payment of fines into union treasuries under penalty of being refused union labor. This constitutes conspiracy to extort money. Illustrations of this kind from the testimony are:

Forcing employers to pay fines for failure to appear before the executive committee on demand.

Fining employers because members of a union worked overtime without securing permits from the executive committee.

Fining employers for permitting painters to fill plaster cracks when at work on walls and ceilings.

Fining employers for poor work done by members of the union and compelling employers to have such work done over at their own expense.

7—All provisions contained in existing contracts between unions or associations of the same, on one hand, and employers or associations of employers, on the other, giving preferential treatment in the supply of labor and to employers who are members of such associations are to be forthwith cancelled. All future contracts of such character are forbidden. No employer of union labor is to be discriminated against because he is not a member of the employers' association.

In some of the contracts exposed before the committee the unions have agreed not to furnish labor to an employer not a member of the association and have permitted members to charge exhorbitant profits on labor such as in the case of the marble industry, in which employers agreed to pay $15.25 a day for a setter and helper. All these agreements and practices must be terminated.

No Intrusion of Union Into Business Affairs of the Employers

8—The constitution should be amended to preclude any union from intruding into the business affairs of the employer and in such manner as to limit jurisdiction and activity of union matters legitimately concerning the welfare and betterment of members.

In this connection Mr. Untermyer cites the case of the new Ambassador hotel, whose proprietor was compelled by plasterers to tear down a wall because the delegate, a plasterer, reached the conclusion that he did not like the color and style of the work, though this was entirely staisfactory to the owner and architect.

9—Where necessary there should be amendment of by-laws to prevent union officials and executive committees from imposing unjust and extortionate penalties on employers. An illustration of this is the compelling of employers to pay one-quarter of a day's wages to men kept waiting in line more than ten minutes for their pay.

10--All regulations and practices that restrict freedom of the owner or builder in the use of appliances approved by the public authorities or that require parts of work to be done at a building wihch can be more economically done at the shop, should be rendered impossible in future by proper regulation. Existing provisions should be repealed and unions and their delegates forbidden hereafter to enact regulations that permit them to punish or discipline employers for the so-called offence of "rushing" or "driving." The aim should be for efficiency. Such regulations put a premium on inefficiency.

No Short Week

11—The unions should be deprived by amendment of the power to prohibit their members from working more than five days a week and of the power to fine or discipline them for working on any day other than Sunday or a legal holiday.

12—Any delegate or business agent who has been convicted and served a prison term for extorting money or using his position as a means to coercion should be made ineligible to future appointment.

13—Regulations should be adopted prohibiting any union or business agent from enforcing a scale of daily work.

14—With respect to plumbers' unions, the following regulations in force must be abated: providing that only one helper may be employed to two plumbers; that the helper cannot use tools if the plumbers are using tools on the job; insistence in the cement masons' union that where two men are employed on a job one must be paid a foreman's wages and that where four are employed one of them shall handle no tools.

15—With regard to metal lathers, the rule requiring employment of lathers on a job wherever concrete is being poured by common laborers, that compels the employer to have a foreman look on while the work is being done by the laborers, though there are lathers on the job, is unreasonable and should be abolished.

16—Painters' unions have a rule that where the office of an employer is located in a city other than that in which the work is being done the rate of wages that prevails in the city of the employer's residence must be paid. There is no reason in such a regulation.

17—Under Section 19 of Article 7 painters' unions allow only one apprentice for every ten men or under, but no shop is allowed more than two apprentices, no matter how many men may be employed. If such limitation is continued there will soon be only one painter to every ten now in the trade. This regulation should, of course, be repealed.

Advantages of a Topographical Map in City Planning

Cost of Making Such a Map is Compensated for by the Ease With Which Civic Improvements Are Laid Out —Costly Errors are Obviated

By J. C. GRINNALDS
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Paper presented before the American Society for Municipal Improvements

It is a settled fact that a map of a city on which to study and lay out a plan for any proposed extension of the street system is necessary. It is a requisite, too for replanning old parts of the city, to systematically study traffic conditions, to show offsets that break the continuity of streets, to show bad angles, block distances, dead end streets, inadequate widths and inefficient functioning of existing thoroughfares. A map of some kind on which to lay out a major street plan is absolutely necessary; and since zoning is an essential part of city planning, its requirements must be supplied, and maps are indispensable for a zone plan, indeed they are a part of it. There are many other reasons why a map of a city is necessary in planning.

Planning Without Sufficient Information

If it may be accepted as a condition precedent to studies for drawing a city plan that some kind of diagram of the present layout is necessary, then the kind of maps must be determined. Suppose those at hand are similar to the common well known automobile maps which show merely street alignment depicted to a scale of approximately 2,000 ft. to 1 in. or 1,000 ft. to 1 in. Of what service would a map of this kind be? If it were noticed that there were in some places two parallel streets which ran thus for, say 1,000 ft. or more without a connecting cross street, the city planner might say, "Why not open between these two parallel streets, a cross town street which is dead ended on opposite sides of this long unbroken block?" He can see from inspection of the diagram what seems to be a desirable opening. It is not apparent from such meager information that the grade on the proposed connection would be as heavy as 10 per cent. Why? Because there were no elevations given nor were there contours showing approximately the probable grade.

Imagine another problem that must be solved. Several parallel streets are shown on this diagrammatic map, crossing a railroad yard which lies contiguous to a railroad main line. There is no indication to guide the engineer in his diagnosis of the kinds of crossings over the tracks. Are they at grade, are they elevated above the tracks, or are they depressed below the tracks? If such crossings as exist are dangerous, what is the remedy? He cannot tell positively, with no more facts to help the solution. If he had a contour map which showed the relative locations to scale, he would know at once the conditions on the ground and where to look to find the railroad in a cut or on a fill where the streets could cross overhead or underneath, respectively. In one or both places he would advocate a bridge. Innumerable cases can be cited where it is absolutely necessary to have a topographic map showing contours and surface detail for study on which to base a comprehensive city plan.

Kind of Map Necessary

From the foregoing, it seems that a map is necessary and further that it should be a topographic map. Assuming that to be a correct conclusion, the next step is to determine what the map should show. The first consideration is the existing street layout. All streets that are built up or marked on the ground should be recorded by the field survey parties and plotted on the map. Old lanes and drives should be included. The office force should be employed at the same time, compiling all data accessible for platted parcels of land. Many such subdivisions have been laid out on paper with no streets having been staked off on the ground. All plots on record or of which any information can be obtained should be located on the field sheets when they come in. Improvements such as buildings of all kinds ought to be located on the field maps, including railroads. street railway lines, streams, shore line, lakes, reservoirs, retaining walls, dams, bridges, quarries and wooded areas. Fences and their character, such as wire, paling, rail or old fence lines, hedges and rows of trees that might indicate old property lines, are requisite to a good map. The state of cultivation is desirable, differentiating by suitable standard signs, orchards, meadows, plowed land, corn fields, pine woods, etc. Lastly, contours must be located and plotted.

Scales

Having decided what physical features are to be shown on the topographic map, it is necessary to determine the scale and contour interval. The former ought to be one which is readily plotted in the field on a field drawing table. When it is remembered that rows of brick houses are to be shown, it is not practical to draw them at a scale less than about 200 ft. to 1 in. To be able to scale within a foot or two the width of a street or sidewalk, the above mentioned scale is almost the minimum. The well known map of Baltimore, made by the Topographical Survey Commission of that city in 1894, is a masterpiece of that kind of work. It is drawn to a scale of 200 ft. to 1 in., with a contour interval of 5 ft. It was found to be admirably suited as a base for working out a plan for streets in the hitherto unplanned territory within the city. The contour interval of 5 ft. seems to be right for street design and determination of grades. It may be that over very flat terrain a lesser interval may be necesary for sewer design and to a lesser degree for water main locations.

Degree of Accuracy

Here it is well to decide how good the map must be from the point of view of accuracy. It should be based on a primary triangulation system, the stations of which may be regarded as nearly permanent and accurate to within ten seconds for closure of any quadrilateral. The secondary and tertiary stations should be almost as good as the primary. There ought to be one or two accurately measured base lines, corrected for curvature. On the triangulation there should be run out all the main roads and cross-country, a traverse control with a maximum error of 1 in 10,000 or 1 in 15,000. The reason for these standards of accuracy is that after such a map is complete, there is left on the ground a control from which detailed property surveys can be made, street intersections computed and established co-ordinately in the downtown districts where assessed land values are high. Traverse points should be iron rods or pipes placed in the most protected places along highways or in open country, or copper bolts set in curbs or on sidewalks, all well referenced for future use. A set of precise levels ought to be spread over the area to be mapped, bench marks being placed in the most permanent structures at about ½ mile intervals. Wye levels can be run to traverse points and temporary stadia stations. Maximum error for precise levels should not be over about 3-16 in. to the mile.

Costly Errors Obviated

Why all this elaborate, detailed description of a map and what is the excuse for making it? Cities used to be laid out without one, it is true. What kind of a layout was it? Well, when a street was designed to be a straight street, it was so drawn on paper, so built on the ground and regardless of hills or ravines, it kept on. The costs heaped up for cuts and fills and bridges. If the way lead to a railroad, it passed over at grade more than likely, leaving a heritage of danger for several generations, ultimately saddling the taxpayers with the burden of expenditures to eliminate, at considerable cost, the death trap. Had a map been available, showing by contours the existing hills, valleys, streams, railroads, etc., it is probable that the entire plan would have been different. When a large city of to-day was in the village or town stage, its whole scheme of streets would have been designed to fit the topography had proper maps been made. The present small town should benefit by the costly lessons that the large ones have learned too late to greatly alter the downtown sections without prohibitive cost.

Steps in Planning

Take the initial stage—suppose a new city is to be built on a proposed site. The topographic map is made. It is possible to determine at once certain rocky, precipitous cliffs, bluffs, wooded ravines, steep hillsides and other suitable areas for future parks. These may may be eliminated from the flat or gently rolling terrain so well adapted to building and over which a street plan must be studied. The old country roads, shown on the map, are the existing highways of travel. Some may fit in with a general scheme and others will not. A study will reveal the natural location of the points of ingress and egress for railroads. They will not come into town over the hills. They will enter by certain low-grade lines and along them will be suitable territory for industrial development. On the higher ground it will be the housing area. It is necessary to determine where the central business area should be. These various districts must now be connected. Radials from the centre of town to the outlying sections must be provided. Crosstown and circumferentials must be provided. These streets are the basis for a major street plan. They need not be absolutely straight. The alignment may be determined by the contour of the ground, thereby giving easy grades but with the most direct route consistent with reasonable grades.

New Territory to be Laid Out and Old City Replanned

An old city that requires a plan for undeveloped or recently annexed territory, and that needs replanning in built up portions, requires a topographic map. In almost every city of that type the street plan was drawn on a flat diagrammatic map. With the general information shown on a complete topographic survey, it is well to work out proposed extensions of the park system, reaching out into the undeveloped country, embracing the ravines, etc., and certain other land suitable for parks. These may then be connected by proposed parkways. These areas being determined it is unnecessary to lay them off into streets. The city plan is simplified to that extent. The major street plan may be laid down on broad lines. Existing grades may be corrected. Slight alterations may serve to give good results. Certain sharp curves may be eased up by curves of longer radii and offsets may be cured by cutting off some corners. The buildings being shown, studies of the cost of widening may be made and where it is necessary to accommodate present or future traffic, a new building line may be determined and fixed. The map gives a good idea of the kind of improvements situated within the new lines. In the old parts of town the elevations may show a major street to be necessary on a high grade and not far distant a low grade artery may be indispensable. Provision can be made for connections between the two. In outlying territory, similar conditions may prevail. In the absence of a contour map this could not be seen without a close inspection of the ground and even then the exact locations could not be made unless a survey were available.

Efficiency and Economy

The old checker board street systems are not practicable, efficient or economic over rolling land. Once upon a time that was the only practice. Closer study with broader information at hand and more intensive efforts at scientific planning have tended to make a street plan more nearly fit the natural ground. Some cuts and fills can not be avoided but they can be reduced in number and in magnitude, by a more rational layout which is not only less costly by being more readily adaptable to the surface, but after all it is more beautiful. The monotony of the long uninteresting city streets so common in all cities will give way to the gently curving and sometimes winding park-like road. A contour map is the best possible guide for the city planner. It is likewise a guide for those who would develop land for sale as lots. They can see from such a map how best to make a street layout involving the least expenditure for grading and giving the best street connections. New streets can be made coterminous with those already existing or a good reason for not doing so will usually appear on the map showing contiguous property. Much money can be saved to the city and to the land owners by the use of a good survey, and its cost will be returned many times. Indeed, grading cost alone on one or two of the existing main highways of some of the large cities has amounted to more than a topographic map would cost and, had it been available, the alignment might have been different, avoiding part of the outlay for grading.

Grade Crossings Avoided

Outside of what we might call the congested part of town and farther toward the outskirts, major streets may be laid out almost a half mile apart and crossings or railroads and deep gullies may be situated at about 5-mi. intervals. These railroad crossings can be readily determined by studies of the topography. It may be found that where the road is in a cut or fill, there is the logical place to cross instead of at grade any old place, as they used to do. The writer emphasizes the grade crossing menace and its abolishment by proper study, because it is so prevalent in all towns.

Sewer Design Depends on Topography

No other feature of city building depends more on the topography than the sewers. The $20,000,000 expended on a comprehensive sewergae system for Baltimore was based entirely on the map of 1894. On it the natural drainage could be traced and the storm sewers followed it. The drainage area could be readily computed and the size of mains determined. Sanitary sewers were designed, too, from study of the surface as surveyed by reasonable deductions as to the use to be made of certain kinds of land. Grades, too, were an important factor. Water mains are more easily located by having a map showing all physical features so that the pipes may conform to the hydraulic gradient and the areas they are to serve will have their bearing on the size.

Rapid Transit

For thorough study of a proposed rapid transit system, a topographic map is essential. Elevations of streets, railroads and streams will give a clear conception of what levels the underground system will have to meet. If an elevated structure is necessary the same data is available and where the way may be in open cut on the surface, or on fill, safe and properly located crossings will be situated at suitable intervals.

Correct Base Map for Zoning

Since zoning is a part of city planning, inquiry as to the kind of map on which to base zoning studies is apropos. It seems necessary to have a correct and complete representation of all present conditions. The buildings must be shown in order to draw clearly in detail an existing use map of the city to be zoned. A good base map would show on inspection that the buildings are of frame, brick, or stone construction. It will appear that some of the buildings are attached, that is, built in rows without side yards. Others will appear to be of the type known as semi-detached houses built in pairs, joined on one side with one side yard to each unit of the couple. Detached houses with two side yards to each house will be noted. Such a map as has been recommended above will show the buildings which sit back from the front lot line and those that are built up to the street line. The fundamental maps on which zoning studies are based can readily be prepared. It will be easy to give each a color to denote its use such as one-family residence, two-family residence, three or more family residence, business, industrial and nuisance uses. Other sets of fundamental maps can be prepared easily, showing by color the heights of buildings and the assessed land values on a front foot basis.

Necessary Guides in Selecting Zones

Certain other studies preliminary and essential before drawing a tentative zone plan, can be made from the topographic map. The built-up areas are noticeable at a glance. The trend of growth out the main highways and the development between them is apparent. Parks and cemeteries, where people do not dwell and, therefore, where zoning for residence or business will not be necessary, show on the map. It will show by the contours and physical features, the lands suitable for future parking, along the streams, ravines, cliffs, etc., where the land is not so adaptable to building purposes. Low, flat lands along the water front and railroads, suitable for industrial sites, for railroad yards, warehouses, piers, docks and shipyards are readily determined. The topography directs attention to the areas suitable for residential development. They can be so designated on the proposed use district maps. Housing areas convenient to industrial districts, to secure ample and satisfied labor supply are necessary. They are chosen with great care and discrimination, with due consideration for the existing developments. The engineer can with understanding, with knowledge of the growth of the city, with information shown by contours, select major traffic streets which will probably become retail business streets or heavy commercial haulage ways. Parkways and boulevards for the highest class residential frontage may be well chosen. All of these aspects of a zone plan are at once before the engineer or city planner who has an accurate, comprehensive topographic map upon which to work.

Corrosion of Cast Iron Water Mains

Causes of Interior Deterioration and Methods of Protection—Bituminous Varnishes are Commonly Used—Centrifugally Cast Iron Pipe is Less Subject to Corrosion

By W. RANSOM*

Waterworks engineers are continually receiving complaints of inadequate water supply, which, upon investigation, are found to be caused by the internal corrosion of the water mains, restricting an otherwise good supply of water. It is possible to find some relief by the employment of scrapers and other mechanical devices, but too often the only remedy is to take up the old mains and relay with mains of a larger diameter. This short paper is an attempt to explain the cause of the internal corrosion of water mains, and to give the best practical means for its prevention.

The oxidation or the rusting of iron is something more than the combination of iron and oxygen. The presence of carbonic acid accelerates the chemical action. Water which contains free CO_2 will have a very decided corrosive effect on cast-iron mains. Unfortunately, the rust which is formed does not act as a protective coat, for the rust is hydroscopic, and allows fresh water to come into contact with the iron to continue the process of oxidation. The chemical action produces a certain amount of heat, which still further increases the process or oxidation.

There are several forms in which rust appears in water mains, and they have been classified as follows:—

(1) Coarse blotches or blisters which increase by the addition of concentric layers. In large mains the incrustation may form a layer 1½ in. in thickness. If the rust be scraped off the process of incrustation will continue on the new surface.

(2) A rusty mud with a yellow tinge which is deposited in the mains and is of a slimy nature.

(3) A graphite change in the metal of the mains, causing it to assume a spongy nature, and is produced by the action of weak acids upon certain materials. This action can take place in spite of a protective coat, and the only safeguard is to have water mains of a good quality.

The acid theory of corrosion is based upon the fact that a weak solution of carbonic acid is strong enough to convert a portion of the iron into a ferrous salt in a very unstable condition. At the same time hydrogen is evolved, which imparts a very bad flavour to the water. The ferrous salt is acted upon by the water and free oxygen, and liberates the CO_2 to continue the work of corrosion indefinitely. It will thus be seen how important it is to limit the free CO_2 in public water supplies, and also, where it is present, to avoid emptying the main as much as possible so as to prevent the presence of oxygen to continue the work of corrosion.

The electrolytic theory is the latest one to explain the corrosion of iron, and is based upon the formation of an "electrical current being set up due to difference in potential between the iron ions passing outward into solution and the hydrogen ions from the electrolytic pure water towards the iron." The action is a very complex one, and in recent years many experimenters have been at work upon the subject.

Discoloration of Water

In some waters not only does the ordinary corrosion of the mains proceed at a rapid rate, but the water is badly discolored, and upon distribution a brown deposit takes place. This is due to the presence of a large amount of CO_2. The acid solution produces ferrous carbonate or bicarbonate and liberates hydrogen is already explained. The ferrous carbonate when it absorbs oxygen from the water or the air oxidises into a brown hydrate and CO_2 is liberated. Ferrous carbonate will not dissolve in water, and the main would very quickly become entirely choked were it not that, in the presence of water containing CO_2, the ferrous carbonate will dissolve and by absorption of more CO_2 is converted into a soluble carbonate, which is passed on to the consumer instead of being deposited in the mains. This soluble bicarbonate, by the absorption of oxygen, will be precipitated into a brown hydrate. If this be done in the main a turbid condition is imparted to the water, and upon being drawn off the water will gradually clear, leaving the brown deposit. If the oxygen is not absorbed in the main the water is drawn off clear, and the oxygen is absorbed from the atmosphere and gradually becomes turbid until the brown hydrate is precipitated.

The remedy for this state of things is to effect the removal of the CO_2 from the water rather than in the treatment of the water mains.

Cast iron resists corrosion better than wrought iron or steel, and this superior resisting property is due to the hard skin formed on the outer surface of the cast iron during the process of casting. The nodules of rust which are formed inside the main consist of the iron dissolved out from the pipe, and appear in the form of a soft mass with a black central core. These nodules increase and check the rate of corrosion, until there comes a point when the incrustation appears to be able to offer a sufficient protection to further corrosion. When scraping is resorted to a new surface is exposed, and the process of corrosion is again brought into operation.

Another form in which rust appears in cast-iron pipes when exposed to electrolytic action is that of black nodules composed of iron, iron oxide, carbon and silica. The change is effected in the iron without much apparent increase of the thickness, but ultimately the quality of the iron deteriorates.

Methods of Protection

There are two chief methods for the protection of cast iron from rusting—viz., coating with an oxide film or coating with paint or varnish.

An oxide film can be imparted to cast iron by passing superheated steam over the hot iron. The water vapour is decomposed, and the oxygen combines with the iron to form a protective film. This process is known as the Bower-Barff method, from the names of the two manufacturers who most successfully applied it. If the film becomes broken oxidation will be at once set up.

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*Paper presented recently at a conference of the British Waterworks Association held in connection with the Public Works, Roads and Transport Congress.

Bituminous varnishes are the most common means adopted for the protection of cast iron. They consist of various mixtures of coal tar, pitch, &c. Dr. Angus Smith's method is the best, and consists of first cleaning the iron and then heating to 700 deg. The pipes are then dipped for fifteen to twenty minutes into the special mixture at a temperature of about 300 to 400 deg.

Tar and bituminous coatings are free from oxygen, and therefore there is no tendency for rust to form as long as the coat remains intact. Every care should therefore be taken during the transit and unloading of the pipes to prevent damage to the protective coatings.

A wash of Portland cement affords a measure of protection against corrosion.

Beyond the ordinary corrosion of mains a flocculent black slimy matter is deposited by water containing iron in solution. If such waters are slightly acid by reason of vegetable matters such as peat, an organism known as crenothrix is able to develop. The germs attach themselves to the inner surface of the mains and live on the carbon compounds which are found in a soluble organic compound of iron, and iron oxide is deposited during growth. The germ first appears as minute specks of jelly and develop into long threads. The remedy is to remove the vegetable matter by filtration and the iron by means of aeration.

In recent months a new form of cast-iron pipe known as the Delavaud spun pipe has been introduced. The metal is cast by centrifugal action, and the resulting spun pipe is uniform in thickness, solid in structure, of high tensile strength, and free from blow and sand holes. It is claimed that the greater density of the material renders the pipes less liable to corrosion than the ordinary sand-cast pipe.

E. I.C. Annual Meeting

The annual general meeting of the Engineering Institute of Canada, with which will be associated a professional meeting under the auspices of the Montreal Branch, will be held at Montreal, on January 24th and 25th. The programme is as follows.

Jan. 24th, 9.00 a.m.:—Registration, E. I. C. headquarters, 176 Mansfield St.
10.00 a.m..—Annual meeting called to order.
1.00 p.m.:—Informal luncheon, C.P.R. Windsor Station.
2.30 p.m.:—Resumption of business meeting and president's address.
7.30 p.m.:—Banquet, followed by smoking concert.
Jan. 25th, 10.00 a.m.:—Visit to Dominion Engineering Works, Rockfield.
1.00 p.m.:—Luncheon, Rose Room, Windsor Hotel.
3.30 p.m.:—Professional paper at headquarters.
8.15 p.m.:—Professional paper at headquarters.

Accommodation for visiting members will be reserved at the Windsor Hotel. The Montreal branch extends a cordial invitation to all members.

The Brown Corporation, who conduct extensive operations in pulpwood, sulphate pulp and lumber at La Tuque, Quebec, have just completed a new clubhouse for the use of their employees.

Money Saved on Small Job

The Use of Mechanical Equipment Instead of Hand Labor on Water Main Job Saves $52 a Day

By the use of equipment on a job so small that ordinarily the contractor would employ hand labor, Q. J. Winsor of Elyria, Ohio, saved $52 a day on a small water-main reclamation job.

Mr. Winsor described the job and his method of handling it in the following words in the A. G. C. Bulletin.

A saving of $52 a day was made on a small water-main reclamation job, because the superintendent found available a small crane and put it to work, instead of digging the pipe out by hand.

About 300 feet of cast iron pipe, that had been in the ground for 15 years, had been cut out of the present water supply system and the city thought it was worth salvaging. This pipe lay under an old water-bound macadam road at a depth of about six feet in the soil that had become about the hardest kind of hard clay.

No Excavating Equipment

As the city had no excavating equipment of its own and the job was very small, the usual thing would have been to dig it out with pick and shovel. In this case the superintendent happened to hear of a light crane that could be hauled quickly to the job behind a motor truck, and decided to try it out.

The crane has wide steel traction wheels and was towed the two miles to the job behind a 3-ton truck, the trip taking about 45 minutes.

The equipment was a half-yard excavating bucket, reaved to get the greatest closing power and epuipped with teeth. The bucket had to dig through about 8 inches of macadam before it struck the hard clay. No trouble was experienced in doing this and fair loads of clay were taken out each trip. The trench was made just the width of the bucket, and after it got down about six feet digging became a little slower, as the bucket did not dig sufficient side clearance to allow it to drop readily.

Care had to be taken as the bucket approached the pipe so as not to break it, but this did not slow up the work much. No pipes were broken and the bucket cleaned out clear to them, so that all the shovel work necessary was to dig out the joints.

The trench was dug three feet wide and from six to seven feet deep. The total time taken was a day and a half, though two days were counted to allow for getting the crane to and from the job.

The superintendent said of this job that, at the rate his men were working on other and previous jobs, the crane took the place of about 16 men. He was paying a regular rate of $.50 an hour; so figured on a 9-hour day basis, without the crane the job would have cost $144.00. With the crane costing $20.00 a day including operator and fuel, the cost was $40.00, which deducted from $144.00 leaves a net saving of $104.00, or $52.00 a day.

It is very probable that similar savings may be made on many small jobs, particularly now that there is a large amount of idle equipment that might as well be used.

Mr. Stanley Lucas, a young engineer of Hamilton, and son of the late R. A. Lucas, of Lucas, Steele & Bristol, died recently in that city.

What Causes Shoving of Asphalt Roads?

Co-operative Investigation Being Carried Out to Determine the Reasons for this Defect—The Whole Question to be Thoroughly Analyzed

By PREVOST HUBBARD
Chemical Engineer, the Asphalt Association

Paper presented before the American Society for Municipal Improvements

In common with other types of pavements, many cases of defects in asphalt pavements are due to foundation or subgrade troubles. While the shoving of asphalt pavements is most often attributable to such troubles, it is nevertheless true that in some cases shoving has occurred from other causes. For this reason during the summer of 1921 an investigation of the cause and correction of shoving of asphalt pavements was undertaken by the U. S. Bureau of Public Roads, with the co-operation of the cities of New York (Borough of Manhattan), Philadelphia, Baltimore, Washington and Detroit, and the Asphalt Association. At the time this paper is written, the investigation is in its initial stages and no results have been obtained or conclusions drawn. It has been suggested, however, that an outline of the investigation would be of interest to quite a number of engineers who would wish to keep in touch with the progress made and could, from their own experience, offer many helpful suggestions. What follows, therefore, should be considered only in the nature of an outline, together with a brief consideration of certain elements which it is believed may have an important bearing upon the subject.

Shoving Only an Occasional Occurrence

In the first place shoving or tendency to shove is not an inherent characteristic of asphalt pavements, as evidenced by millions of square yards of satisfactory surfaces varying from one to forty years or more in age and subjected to all conceivable conditions of exposure and traffic. It is rather to be considered as an occasional manifestation which in many cases may be corrected by cutting out the deformation and replacing the old wearing course mixture with new, thus forming a patch. More often than not, when waves or deformations are noted in an asphalt pavement most of the adjacent surface in the same line of travel and with the same exposure is found to be true of contour. Except where failure of the foundation is evidently responsible, comparatively few cases are to be found where a high percentage of the wearing course even in the direct line of travel has shoved. It would, therefore, appear that where shoving occurs some condition or combination of conditions is responsible which if thoroughly understood would make it possible to prevent absolutely such defects in future construction.

Whatever the conditions are which make shoving possible, the primary cause of shoving is traffic, which produces a rearrangement of the mineral particles in the paving mixture to an appreciable depth from the surface down. On pavements which are sufficiently wide to allow two lines of traffic in each direction it will ordinarily be found that the formation of transverse waves is most prevalent near the gutter, where most of the horse-drawn and slow-moving-motor traffic finds its way. While it is probably true that the impact of fast-moving traffic will accelerate shoving, once started, or may be directly responsible where irregularities in contour first existed, comparatively slow moving heavily loaded vehicles are believed to be the predominating cause.

Rutting

In addition to the formation of transverse waves, which seldom extend entirely across the road, rutting is sometimes noted. This is almost invariably due to the very close tracking of vehicles and usually extends for a considerable distance in two continuous parallel lines about as far apart as the ordinary spacing between the wheels of vehicles. Rutting is due to lateral displacement of the paving mixture, which seldom occurs in wave formation, although around curves and at intersections waves due to the side thrust of vehicles are sometimes to be found.

Certain general conditions which tend to promote shoving by producing an unstable paving mixture are quite well understood, but it is believed that there may be much yet to be learned regarding the limits of such conditions. These and other conditions are listed below for the purpose of illustrating the complexity of the subject from a research standpoint.

Conditions which Tend to Promote Shoving

Foundation Faults:

1. Lack of support from below, causing local settlement of the foundation.
2. Uneven contour in foundation, causing variable thickness of asphalt paving mixture and consequent differences in compression.
3. Very smooth foundation, which may promote slipping of the asphalt paving mixture over its surface.

Inferior Paving Mixture:

4. Use of too soft an asphalt cement for the climate traffic, or the grading of the mineral aggregate.
5. Use of too much asphalt cement in the paving mixture.
6. Poor grading of mineral aggregate, which creates instability of the paving mixture irrespective of the consistency and percentage of asphalt cement with which it is mixed.
7. Use of an excess of rounded particles of mineral aggregate in the paving mixture.

Construction Faults:

Uneven contour due to faulty spreading, raking or rolling of the paving mixture during construction, or lack of uniformity in the composition of the paving mixture.

9. Lack of proper initial compression during construction, which may be due to use of too light

a roller, too little rolling, to the mixture being too cold when rolled, or too great thickness of course for a single rolling operation.

10. Faulty repairs to service openings.

Exterior Causes:

11. Absorption of an excess of oil or gasoline drippings, causing undue softenings of the asphalt cement.
12. Gas leaks from main below the pavement structure, causing undue softening of the asphalt cement.

Investigation from Several Angles

It is evident that a comprehensive investigation of the shoving of asphalt pavements must take cognizance of the factors just mentioned in arriving at any general conclusions. With this in mind it is planned to study this subject from a number of angles. To start with, existing pavements having the most complete history records available will be examined and samples taken from these pavements for complete laboratory tests. Already about 40 tentative locations have been selected in each of the five cities whose co-operation has been secured and samples of the pavements are being taken under the supervision of the U. S. Bureau of Public Roads. These locations have been carefully selected so as to obtain samples from the same pavement as close together as possible, where the surface shows (1) a marked hump, and (2) depression, and (3) an area of uniform contour, as well as from pavements which have shown no indication of shoving,

It was hoped that samples might be taken by means of a core drill mounted on a truck which would proceed from city to city until the entire lot had been secured. It was found, however, that the core drill could not be used successfully, for this purpose and it was decided to cut out samples approximately 1 ft. square by means of an asphalt cutter and to saw each sample into four sections after it had reached the laboratory. The saw used for this purpose consists of a revolving carborundum saw having a steel center, to which is cemented a rim of carborundum and which is operated with a plentiful supply of water under pressure. From each large sample two small sections are to be examined by the municipal laboratory, and two by the Bureau of Public Roads, so that all results will be checked.

A comprehensive record sheet has been adopted for use in connection with each sample, and in every case will be filled out as completely as possible. The sheet covers in detail five broad subjects: (1) general information, (2) specifications, (3) paving plant and construction record, (4) sampling record, and (5) test record. The sheet was prepared primarily for use in connection with sheet asphalt and fine aggregate asphaltic concrete pavements, as it was thought advisable to limit the investigation for the time being to these types.

The laboratory tests on samples will consist of a determination of the density of each course of paving mixture and in some cases of the upper and lower halves of the wearing course The samples will then be extracted with a suitable solvent to determine the percentage of bitumen and to recover the mineral aggregate for an accurate mechanical analysis and specific gravity determination. The bitumen will also be recovered for a determination of its specific gravity, but information relative to its consistency or penetration will be obtained either from the original municipal laboratory record or from a direct determination made upon an original file sample if it is available. While it is realized that the consistency of the asphalt may have changed during its service in the pavement, no reliable method has as yet been devised for ascertaining its consistency from a sample of extracted bitumen.

From the determination of specific gravity of the constituents of the mixture and the weight proportions in which they were combined, the maximum possible density of the mixture may be calculated and the actual percentage of voids in the pavement sample may then be ascertained by comparison with the density determination first made. By heating a portion of the original sample until it has softened to a sufficient extent it may be compressed to its maximum practical density in a mold, and by a comparison of the density of this specimen with its original density, some idea may be obtained as to whether or not the pavement shows lack of compression.

All test results will be carefully considered with respect to other data shown on the record sheets, including character and finish of foundation and character of subgrade, before any tentative conclusions are drawn. It is hoped that from examination of the pavement samples sufficient information will be secured to indicate the character of the paving mixtures which are most resistant to displacement under service conditions. If this can be done, it is then proposed to prepare laboratory specimens of compressed paving mixtures and subject them to a test for resistance to displacement. While all of the details of this test have not as yet been worked out, it is expected that specimens will be prepared with various mineral aggregates and asphalt cements, of different densities after compression and tested under carefully controlled temperature conditions with a device which is at present being designed by the Bureau of Public Roads to duplicate as closely as possible the shoving effect of traffic. When these tests are checked with the data obtained from the pavement samples it may be found quite practicable to develop a set of limiting conditions which will point the way to improvements in existing specifications, or at least emphasize the necessity of more careful conformity with certain requirements of existing specifications.

Provided the results of such an investigation are sufficiently encouraging it is hoped to prove or disprove the conclusions which may be developed, by means of an accelerated service test on experimental sections of asphalt pavement laid on a large circular track over which an automobile truck will be run automatically for a sufficient length of time.

As previously stated this paper is only an outline of the investigation which is at present in its initial stages and it is hoped that engineers who are interested in the subject will feel free to discuss the proposed methods and offer suggestions or criticisms that may prove of value in perfecting the various details which are still to be worked out. All first reports of the results of the investigation will be issued by the Bureau of Public Roads which is directing the work.

The Bureau of Municipal Research, Toronto, has issued an interesting booklet, entitled "City Budget Facts based upon the Official Estimates of the City of Toronto for 1922."

No. 34

Canada's Contractors—A. A. McDonald

The contractor whose sketch we have chosen to present in this week's column is a well known figure in Eastern Canada especially in Halifax, in which city he has carried out a great deal of better class construction work. He is Mr. Alex. A. McDonald, president and general manager of the McDonald Construction Co. Ltd., Halifax, N. S. Mr. McDonald was born in East Bay, N. S., a little over 41 years ago and received his public school education in Sydney. He is essentially a practical man, having served his time learning the carpentering trade. He broadened his outlook, however, by taking a course with the International Correspondence Schools. A number of large projects in Nova Scotia took up his attention in various capacities, these including the Marconi Wireless plant and pier No. 2 at Halifax, on which Mr. McDonald acted as superintendent for the Nova Scotia Construction Company. After thus becoming thoroughly acquainted with the construction field, he started his present business in 1915, since then handling a good share of the construction work available in and around Halifax. A number of very large schools are to his credit. Mr. McDonald is also a director of the Dartmouth Lumber Company. He has interested himself a great deal in public affairs and for six years served Cape Breton as alderman, resigning on leaving for Halifax. Mr. McDonald is also a keen militia man and served for nine years with the Seventeenth Field Battery.

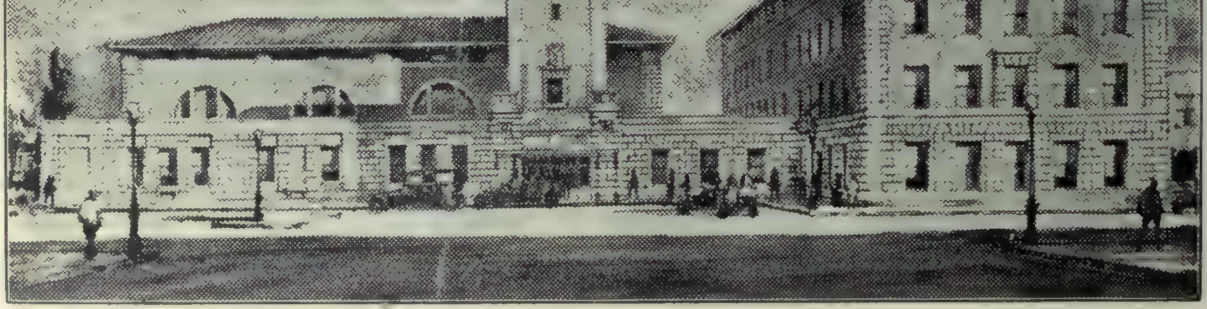
Mr. A. A. McDonald

Municipalities Vote Money for Public Works

On January 1, voting on aspirants to municipal offices and on money by-laws was general throughout the province of Ontafio. A survey of results shows that many by-laws authorizing large expenditures for construction and engineering work were carried by substantial majorities, thus insuring an early start on the projects involved. In a few instances, bylaws authorizing expenditures of this character were defeated.

Alliston favored the expenditure of $40,000 for school extension purposes and Palmerston carried the bylaw to extend the electric works. A 2-room addition to the public school of Cobourg involving an ex-

New C. P. R. Station at Moose Jaw, Sask.



penditure of $12,000 was favored, while Cornwall ratepayers authorized the borrowing of $75,000 for school extension. In Bridgeburg, also, additions to a school as well as well as a new town hall, were sanctioned. These were estimated to cost $30,000. Stratford favored the spending of $52,000 for a new wing to the General Hospital and $47,000 for the Isolation Hospital, also $7,000 for a new bridge over the Avon River at John St. Incidentally $30,000 for a bridge at Queen St., in the same city, was declared unnecessary by the voters. A new sewer involving the expenditure of $70,000 was authorized by Oshawa ratepayers. Brantford carried by a large majority a bylaw for a new trunk sewer.

A bylaw to establish a water works in Almonte, at a cost of $300,000 did not meet with much sympathy and was defeated. Bylaws proposing to borrow $200,000 for public utilities and $6,000 for a teachers' residence were defeated at Cochrane, the former by only 2 votes.

Sturgeon Falls' Water System

The town of Sturgeon Falls, Ont., has recently enlarged its water suppy system by the addition of a new pumping station housing two Buffalo pumps, driven by two 100 h.p. motors. A filtering plant and stand pipe have also been installed, the addition costing $80,000. Mr. L. E. Carter, town engineer, was in charge of the work.

Mainly Constructional

The town of Oshawa, Ont., voted the sum of $70,000 for the construction of the Westmount sewer, at the recent municipal elections.

During 1921 there were reported to the workmen's compensation board 45,191 accidents, a decrease of 9,660 from 1920.

It is reported that bricklayers' wages at Toronto, will remain at $1.00 per hour until March 31, when they will be fixed by arbitration.

The bylaw to provide $300,000 for the construction of a water works system at the town of Almonte, Ont., was defeated at the recent municipal elections.

Fire losses in Canada during the week ended December 28th, are estimated by the Monetary Times at $716,050, compared with $798,400 the previous week.

Messrs. Archibald & Holmes, Ltd., general contractors, of Toronto, are moving from the Continental Life Building, to 709 Yonge St., over the Dominion Bank.

Two bylaws, the first authorizing the expenditure of $52,000 for the construction of a new wing to the General Hospital, and the second for $47,000 for addition to the Isolation Hospital, at Stratford, Ont., were passed by the ratepayers at the recent civic elections.

The Montreal Harbor Commission has been disbanded, the members having handed in their resignations at the end of the year. The commission was formed in 1913, going into office the first day of that year.

A gang of 200 laborers recently commenced work on digging the foundation of the new Court House on Notre Dame St. East, Montreal. In order to provide work for as many as possible of the city's unemployed labor, the men have been taken on for a two-week shift at the end of this period being replaced by an entirely new gang for a similar period.

A bylaw passed at the recent civic election in Toronto makes it compulsory for all vehicles to carry lights. The Ontario Motor League, which was behind this measure, propose going a step further, it is stated, and will take up with Hon. F. C. Biggs, Minister of Highways, the question of having this ruling included in highway legislation, making it applicable all over the province.

It is stated that the Manitoba Motor League have developed a plan for a network of highways to serve the entire province and propose introducing the plan at the next session of the legislature.. The plan provides for the construction and repairing of 1,663 miles of main trunk highways of the gravel type.

The employment situation in Port Arthur, Ont., has been considerably relieved by the securing of a contract, by the Port Arthur Shipbuilding Company, for a 10,500-ton freighter, for the Matthews Steamship Company. Between 800 and 1,000 men will be given employment on the commencement of construction of this vessel, the number being increased to 1,200 on the finishing work.

The past year has been an active one in the building business at Hamilton. The annual report of the building inspector's department, issued recently, shows the total value of all structures erected in Hamilton during 1921, at $4,649,450, as compared with a total of $4,340,220, for the previous year—an increase of $299,230.

Personal

Hon. Hewitt Bostock has been appointed temporarily to the office of Minister of Public Works in the new Liberal government.

Mr. Harry J. Allison, consulting engineer, of Long Branch, Ont., was painfully injured in a motor accident on the Toronto-Hamilton Highway recently. The motor bus in which Mr. Allison was riding skidded when slowing up on the greasy pavement and was struck by a motor bus coming from the other direction.

Obituary

Mr. Adam Beattie, formerly construction engineer with the Grasseli Chemical Co., of Magog, P. Q., died recently while visiting relatives at Montreal. Deceased was 67 years of age and was born in Owen Sound, Ont. He had been connected with the above firm for twenty-three years, retiring from business five years ago.

St. Catharines, Ont., lost its most prominent citizen, in the person of Mr. W. B. Burgoyne, who died recently at his home in that city, following a short illness, from heart trouble. Deceased had lived most of his life in St. Catharines and was foremost in all movements for municipal improvements, taking great interest in good roads activities, as chairman of the local Suburban Roads Commission. Mr. Burgoyne was elected to the city council of St. Catharines in 1895 and for three terms served as mayor of the city. The high level bridge over the old canal in this city, completed in 1917, was called after him, in recognition of his work in securing its construction. He was connected with the local Board of Trade and the Deep Waterways Union, and in business was owner and editor of the St. Catharines "Standard".

The De Laval Separator Co., Montreal, have issued a handsome calendar, surmounted by a reproduction in colors of a painting of the Kutenai Indian Girls.

CONSTRUCTIONAL ACTIVITY

Period of January 4 to January 10, 1921

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Almonte, Ont.
Ratepayers defeated by-law which authorized expenditure of $300,000 for waterworks system.

Beamsville, Ont.
Construction of addition to reservoir is contemplated by Town Council. W. D. Fairbrother, clerk.

Fenwick, Ont.
Pelham Twp. Council contemplate rebuilding 20 miles of gravel road, bridges, culverts, tiles, etc., at cost of $40,000. A. N. Armbrust, clerk, Fenwick, Ont.

Harriston, Ont.
Minto Twp. Council contemplate drainage repairs. W. D. McLellan, clerk, Harriston, Ont.

Oshawa, Ont.
Ratepayers passed by-law authorizing construction of sanitary trunk sewer to cost $70,000. N. G. McDonald, Engr. Gore, Nasmith & Storrie, Consulting Engrs., Confederation Life Bldg., Toronto. Work will be done by day labor.

Ottawa, Ont.
Secy. of Bd. of Control will receive tenders until Jan. 31st for supply of steel pipe, 42" valves and fittings required for extension of the 51" Overland Pipe from its present terminal to Queen St. pumping station. Plans with A. F. Macallum, Commr. of Works.

Port Dover, Ont.
Town Council contemplate sewer improvements. Jas. Sloan, clerk.

Toronto, Ont.
Tenders will be received until Jan. 17th for laying and joining water pipes, etc., on Beresford, Alton, Doel, Woodmount, Sts.; Woodington and Slade Aves.; and Strathmore, Wolverleigh, Glebeholme and Milverton Blvds. for Bd. of Control. Specifications at Room 320, City Hall.

Walkerton, Ont.
Waterworks Committee plan repairs to reservoir.

Construction of pavement on Station Rd. is contemplated by Town Council.

Wiarton, Ont.
Town Council plan installation of an electric pump and large engine for waterworks system at cost of $10,000.

Woodslee, Ont.
J. S. Laird, Engr., Essex, Ont., will prepare plans for drainage improvements for Maidstone Twp. Council. A. C. Mousseau, secy.-treas., R.R. No. 1, South Woodslee.

CONTRACTS AWARDED

St. Joseph de Coleraine, Que.
General contract for gravelling rd. at cost of $25,000 for Prov. Govt., Dept. Pub. Highways, is awarded to Isidore Duquet, Lac Megantic, Que.

Railroads, Bridges and Wharves

Stratford, Ont.
A. B. Manson, Engr., is preparing plans for bridge to cost $7,000 for City. Ratepayers passed by-law.

Public Buildings, Churches and Schools

Alliston, Ont.
Ellis & Ellis, architects, Manning Chambers, Toronto, are preparing plans for alterations and addition to school to cost $40,000 for School Bd. Ratepayers passed by-law.

Bridgeburg, Ont.
Ratepayers passed by-law which authorized erection of school at cost of $30,000 for School Bd. W. C. Tait, secy.

Ratepayers passed by-law authorizing expenditure of $30,000 for erection of town hall. C. N. Borter, architect, Niagara Falls, Ont.

Cornwall, Ont.
Mr. Beatty, architect, care of Education Dept., Ottawa, is preparing plans for addition to school to cost $75,000 for Pub. School Bd. By-law was passed by ratepayers.

Edmunston, N. B.
High School Bd. will erect high school at cost of $125,000. R. A. Frechet, architect, 30 Bonnacord St., Moncton, N. B.

Hespeler, Ont.
A. Cober, architect, Rife Ave., is preparing plans for library to cost $18,000 for Town. M. Jarbine, clerk.

Kitchener, Ont.
Ratepayers passed by-law authorizing erection of City Hall at cost of $250,000 W. H. E. Schmalz, architect, 288 Frederick St.

Niagara Falls, Ont.
Ratepayers defeated by-law which authorized erection of police station at cost of $17,000.

Preston, Ont.
Bd. of Education contemplate erection of school. John Cowie, secy.-treas.

St. Hubert, Que.
Erection of school is contemplated by School Bd. G. Avril, secy.-treas.

Stratford, Ont.
Jas. S. Russell, architect, Downie St., is preparing plans for isolation hospital to cost $47,000 for Stratford Hospital Trust. Alex. Fail, Cambrai St.

Erection of school at corner Brunswick and Well Sts. is contemplated by Separate School Bd. M. Dillon, secy., Wellington St.

Plans are being prepared for addition to general hospital to cost $52,000 for Stratford Hospital Trust. Jas. S. Russell, architect, Downie St.

Teeswater, Ont.
W. E. Binning, architect, Listowel, Ont., is preparing plans for school to cost $40,000 for Teeswater School Bd. Ratepayers passed by-law.

Vesta, Ont.
New school section will be formed and school will be erected.

Welland, Ont.
By-law was passed by ratepayers authorizing erection of addition to public library W. E. Forrester, City clerk.

Wiarton, Ont.
Erection of school is contemplated by School Bd. Trustees, J. Lane, W. J. Moon and J. J. Tyson.

Woodroffe, Ont.
Erection of addition to school is contemplated by Woodroffe Pub. School Bd. Trustees, Arthur Glen, John Shouldice and Thos. Sanders.

CONTRACTS AWARDED

Gravenhurst, Ont.
Additional contracts for hospital costing $450,000 for Muskoka Free Hospital for Consumptives, 223 College St., Toronto, are: Excavating, Angstrom & Verochio Ltd., 81 Victoria St., Toronto; structural steel, Sarnia Bridge Co., Ltd., Sarnia, Ont.; steel stack, Canadian Des Moines Steel Co., Inches Ave., Chatham, Ont.; cement, Alfred Rogers Ltd., 85 Bay St., Toronto.

Guelph, Ont
Sheppard & Abbott, 119 Harbord St., Toronto, have plumbing, heating and ventilating contracts for Veterinary Bldg. costing $60,000 at Ontario Agricultural College for Pub. Works Dept., Prov. Govt.

Plumbing, heating and ventilating contracts for dairy bldg. costing $60,000 at Ontario Agricultural College for Prov. Govt., Dept. Pub. Works, are awarded to Purdy Mansell Ltd., 63 Albert St. Toronto.

Griffin Cove, Que.
A. Lachane, Eden St., Levis, Que., has painting contract for decorating church costing $30,000 for Parish.

Moncton, N.B.
General contract for erection of addition to Children's Aid Home costing $5,000 for City is awarded to Stevens & Dobson.

Parry Sound, Ont.
Messrs. McTaggart, James St., Parry Sound, are awarded plumbing and heating contracts for addition to court house costing $40,000 for Prov. Govt., Dept. Pub. Works.

Toronto, Ont.
General contract for erection of tabernacle on Christie St. for Christian & Missionary Alliance is awarded to Dickie Construction Co., Ltd., Ryrie Bldg.

A. Petrie & Co., 457 Roxton Rd., have plastering contract for church costing $20,000 on Sumach St. for Bulgarian Mission. Business Buildings and industrial plants..

ESTABLISHED 1886

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and Engineering Review

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Opening of the Chippawa-Queenston Scheme a Triumph for Canadian Engineers

The first unit of the Chippawa-Queenston power development was officially started up in the presence of Premier Drury, Sir Adam Beck and some 500 visitors from all over the continent on December 28, 1921. What a moment of triumph for Sir Adam and his army of engineers, led by F. A. Gaby and Harry G. Acres, who had planned and labored and hoped for nearly six years, for that very moment! What a triumph for Canadian engineers and Canadian universities, who supplied the inspiration, the brain and the determination to see the thing through to a finish. Perhaps, also, it was no less a moment of triumph for Canadians at large that right within their own borders they had the biggest plant that had ever been conceived and the men to construct it.

It would be a pity if the simple fact that this is a municipally-owned proposition should be allowed to detract one iota from the spontaneity of recognition of the fact that the Hydro-electric Power Commission of Ontario has done a truly wonderful piece of work—and we don't think it will. What ever side of electrical politics one may be on, this is a time to forget everything but that a really great piece of engineering work has been brought to a successful issue through the specialized training of the engineering profession. We can all on this occasion throw our hats in the air and shout "Long live Gaby! Long live Acres! Long live the triumph of Canadian engineers!"

This issue of the Contract Record is given over almost completely to a review of the whole work. We dedicate it gratefully to all Hydro engineers, great or small, who have taken any part in the Chippawa scheme. We realize the incompleteness of our survey but it will at least form an historical basis from which individual studies into the many intricate features of the work may be started. From time to time we shall publish further detailed articles covering, in greater minuteness, this or that special feature. In the meantime it will stand, we believe, as the most complete and comprehensive survey of the work that has been published.

Scientific Research Needs to be Popularized

The American Association for the Advancement of Science, which held its convention in Toronto a few weeks ago, is one of the most useful scientific organizations on the continent. No one who attended any of the meetings could fail to be impressed with the importance of the work of the association, or the tremendous earnestness of the men who were associated with it. The atmosphere surrounding these meetings of "each for the joy of his calling," as Kipling says, strikes one at once, and is in pleasing contrast to the ideal—necessary, no doubt,—of the workaday world which reads much more like "each for the joy of the dollar."

However, the commercial side of life is essential after all, and if one may criticize the very excellent arrangements that were everywhere evident in connection with the recent convention proceedings, it would be that a little more commercialism may have been injected. The work of the scientist, after all, is the basis of our ultimate commercial prosperity and it is unfortunate that this fact is not more generally recognized, and the suggestion we would offer, therefore, is that possibly more effort might have been made to interest the people as a whole in the value of scientific research, in general, and the work of this association in particular.

This criticism, in a word, is to the effect that scientific organizations have not, as a class, grasped the importance of publicity. Those on the inside, of course, know of the good work being done. Those on the outside do not know and, therefore, do not care. The best success can only come when the public, having learned the value of the scientist's work, demand that it be prosecuted further, that the necessary funds be forthcoming and that every encouragement and support be given the men who devote their lives in this way to their country's service.

In all seriousness, we suggest that a little attention be given by this and similar scientific organizations in the way of research into the value of educational work among the rank and file of our citizens, so that they may, of their own accord, become co-operators in this work of research, without which no country can ever hope to become commercially great or stand in the front rank of the nations of the world.

Gunite in Metal Mines

The U. S. Bureau of Mines is conducting an investigation in the Nevada gold-mining fields of the use of gunite in metal mines. The possibility of the cement gun being used in the preventing or minimizing of rock burst in deep metal mines is being given especial attention.

No. 35

Canada's Contractors—J. M. Pigott

At this particular time when the national organization of the contractors of Canada—the Association of Canadian Building & Construction Industries—is deliberating in Hamilton, it is a very fitting occasion to pay tribute to one outstanding figure in the industry, Mr. Joseph M. Pigott, a Hamiltonian, than whom no one has done more in the interests of the betterment of contracting in all its aspects. Convinced of the need for and benefits derived from strong organization and co-operation, among contractors, and endowed with the gift of impressing his convictions enthusiastically and forcefully, he has supported through thick and thin every movement that might improve the status of the contracting business and its activities. Those who have observed his keen analysis of the contractors' problems and who have listened to his sage counsel have recognized in him one of the "big men" of the industry —one whose sagacity and tactfulness, whose enthusiasm and forcefulness and above all, whose friendliness and comradeship have won him the respect and friendship of contractors across the breadth and length of the Dominion.

Mr. Pigott gives practical application to his ideas as a member of many of the important committees of the national association, of which he is honorary treasurer and an active director. Indeed, the association owes much of its prestige and success to his enthusiastic efforts on its behalf. Mr. Pigott has also taken a very keen interest in the Hamilton branch of the national association and, as its first president, was largely responsible for the development of this branch into a very large and live organization.

Mr. Pigott has the contracting spirit in his blood for he is a son of the late M. A. Pigott, one of the best known contractors in Canada in his time, and with whom he was associated in the contracting business from 1904 until 1912. Together they were through many large undertakings of national importance. In 1912 the late M. A. Pigott retiring from business, Mr. J. M. Pigott continued and became eventually associated with Mr. Healy, under the name of Pigott-Healy Construction Co. About a year ago Mr. Healy disassociated from the company but Mr. Pigott continued the business. Mr. Pigott and his associates have had many large contracts to their credit, both in Canada and the States. Amongst others worthy of mention, are the following: The Grey Nuns' Hospital, Saskatoon; the Government armouries, Prince Albert; post office, Edmonton; Armour packing plant, Hamilton; the Canadian Westinghouse office building, Hamilton; the Stroh brewery ice plant, Detroit; Crowley-Milner department store, Detroit; about eight large schools; the Beaver Board Company, Thorold, several additions; the Canadian Cartridge Co. additions. Recently they have completed the large stone college for the Redemptorist Fathers on the banks of the St. Lawrence near Brockville and the half-million dollar addition to the Royal Military College at Kingston.

Mr. J. M. Pigott

Lime Imports and Exports

Canada supplies nine-tenths of the lime that is imported by the United States for consumption there. The quantity, however, is small, as more than 99.8 per cent of the U. S. consumption is produced in that country. Canada imports very little lime from the United States—only a fraction of one per cent of the latter's production.

Test of Non-Freezing Dynamite in Ditch Blasting

A ditch blasting test in snow and ice of the new non-freezing straight dynamite manufactured by the Du Pont Company was made during the last few days of November, near Wausaukee, Wis. The ditch was blasted by the propagated method and the dynamite was loaded through 8 ins. of snow and about ½ in. of ice in wet soil, the temperature of which was 35° F. at the point of the load. Moreover the dynamite used had been exposed in storage to freezing temperatures for several weeks. The results are stated to have been absolutely perfect in every respect.

Trade Incorporations

Park Housing Company, Limited, with head office at St. Lambert, P. Q., capital $20,000 to build dwelling houses.

Montreal Home Builders, Limited, with head office at Montreal, capital $250,000 to carry on a building and real estate business.

Premier Construction Co. Ltd., with head office at Walkerville, capital $40,000, to carry on the business of contractors and builders.

Gunite Used for Steel Protection on Hamilton Entrance Bridges

Two Plate Girder Highway Structures Coated with Concrete Applied by Means of a Cement Gun—Appearance of Bridges Enhanced by Panel Effect

By W. E. JANNEY, C.E., President, Gunite Co. of Canada, Ltd., Hamilton, Ont.

Early experience with the cement gun amply demonstrated that its sand-cement product, known as gunite was economical, impervious to water, more fire resistant than concrete, was not affected by gas or acid fumes, would bond perfectly with brick, tile, concrete, etc., was twice as strong as concrete or mortar, and would build thin walls without loss of quality. It naturally followed that among the many uses for gunite, for which the above qualities admirably fit the material, steel protection should receive considerable attention. It has been a well known fact that cement is one of the best steel preservatives obtainable and gunite was acknowledged a success at its first trial on steel protection work, one of the chief reasons being the quality of the film of cement which is shot against the steel by the cement gun. This is well explained by the following statement of a prominent engineer: "When the cement gun starts, a large percentage of sand under the heavy pressure rebounds until the surface is coated with cement, after which the rebound decreases, the particles of sand embedding in the cement. This acts as a continuous rain and, in my estimation, this, coupled with the hydration, explains the superior density, water proofing qualities, etc., which gunite has over concrete."

Most of the large railways and municipalities of the United States have adopted gunite as the most permanent and economical method for bridge steel protection. Certain Canadian railways have followed suit and in 1921 Ontario followed the example by protecting two bridges in Hamilton, Ont.

In order to provide an adequate entrance to Hamilton, for the Toronto-Hamilton highway, the Ontario Government and the city of Hamilton built a series of five bridges over the ravines and tracks, the city of Hamilton's share being bridges 4 and 5, which are of the beam and girder type, with reinforced concrete slabs and handrails. These bridges were designed and constructed under the supervision of Mr. E. R. Gray, city engineer of Hamilton, who is on record as the first engineer in Ontario to specify gunite for bridge steel protection.

The following is a summary of the specifications for the gunite work on this job. These clauses are printed to indicate what features are essential in gunite work of this character:

1. All exposed steelwork shall receive a protection coat of gunite which shall be 1½ in. thick, reinforced with expanded metal or other reinforcing steel, as approved by the engineer.

2. Cement—same as for concrete.

3. Aggregate—same as for concrete, the sand being screened through a ¼ in. sand screen.

4. Water—same as for concrete.

5. Mixing—one part of cement to three parts sand.

6. Air—The compressor shall be so equipped that the air supplied by it will be as dry as reasonably possible.

7. The water pressure shall be at least 20 lbs. more than the material pressure.

8. Reinforcement—steel shall be made by the open hearth process. Re-rolled material shall not be accepted. Plates, shapes and bolts shall be of structural steel only. Bars and wire may be of structural steel or high organic steel.

9. Reinforcement to consist mainly of expanded metal of 24 lbs. to 100 sq. ft., or equivalent.

10. Reinforcement shall be firmly adjusted and fixed at a distance of ¾ in. from the structural members and shapes to be covered with gunite, except in the case of edges of flanges of girders and beams, when the metal shall be drawn tightly to the edges of the structural members.

11. The reinforcement shall be wired with No. 16

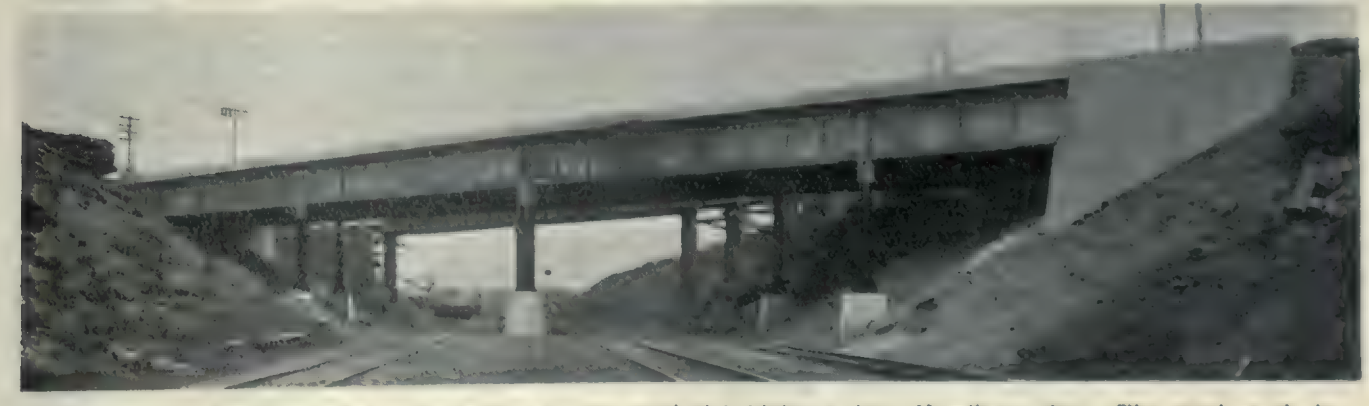


Fig. 1. One of the two plate girder bridges on the provincial highway into Hamilton, Ont. The steel work is entirely protected by gunite

gauge wire to 3/8 in. bars which, in turn, are wired through holes left in the structural members to bars on the far side.

12. The work shall be done under the supervision of an experienced foreman and only carried out by workmen trained and skilled in this class of work. This condition to be rigidly enforced.

13. The finished surface of the gunite work shall be left with the natural cement gun finish, but must have a uniform appearance.

14. Guarantee—the contractor shall be required to undertake to guarantee the entire work to stand in first class condition for a period of 18 months. If the work should develop defects during this period he must return to the site with his equipment and make good any defects.

15. Metal surfaces must be thoroughly cleaned of rust and scale before covering with gunite.

16. Temperature—the gunite shall not be applied at a temperature lower than 35 deg., or when the temperature is liable to drop below 35 deg., within the next 24 hours following the application.

Methods of Doing the Work

The gunite contractors had intended using complete equipment on each of the two bridges, but on account of the other work not being carried on simultaneously on both bridges, they were only allowed to run one crew and, therefore, to handle only one bridge at a time. The plant used was a 12 x 10 Chicago Pneumatic portable compressor, double acting, driven by a 50 h.p. Westinghoust motor; a coke dryer and two type N-1 cement guns. The longest lengths of hose from the guns were 350 ft. The air pressure used at the compressor was 85 lbs., which was reduced at the guns according to the length of hose being used.

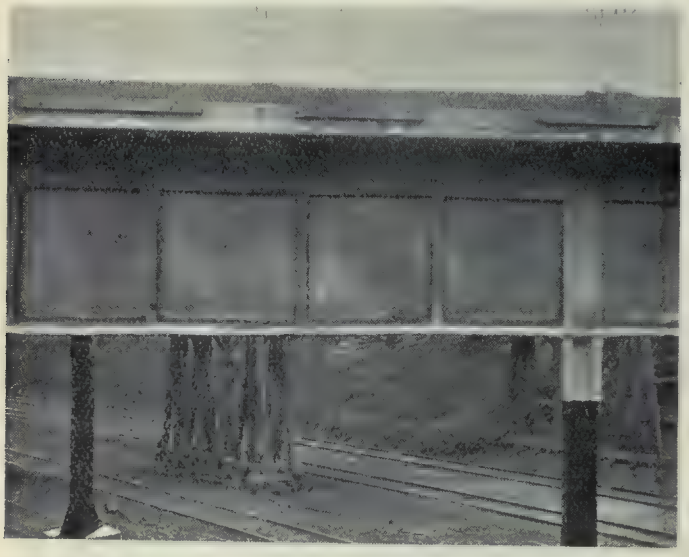


Fig. 2. The gunite was applied so as to give a panel effect and thereby enhance the appearance of the bridge

The crew for operating the plant consisted of one nozzleman and one assistant, one gun runner, one compressor man, three laborers, besides the reinforcing crew and riggers.

The gunite on the girders was applied in three coats and with the aid of shooting strips was given a handsome panelled effect. The first coat was a 1½" blanket applied over the entire area. Then "shooting strips" or rectangular frames of 1" x 5" boards on edge, slightly less in size than the panels of the plate girders, were fastened in place and the area outside the strips shot until the gunite was above the strips. This gunite was then cut with a trowel and the strips removed leaving a deep inset panel A wet flash coat was then applied to finish off the surface.

Fig. 1 gives a general view of one of the bridges, minus the handrail. Fig 2 shows the panel effect on the side girders done by the gun with the aid of shooting strips. The third illustration taken underneath the bridge shows floor beams, lateral bracing, etc., covered with the gunite to protect them from steam, moisture and acid fumes from the locomotives passing underneath.

Tenders called for and accepted were: Concrete foundations, Russell Construction Company; steel work, Hamilton Bridge Works; gunite, Gunite Company of Canada; handrails, Concrete Pipe & Products Co.

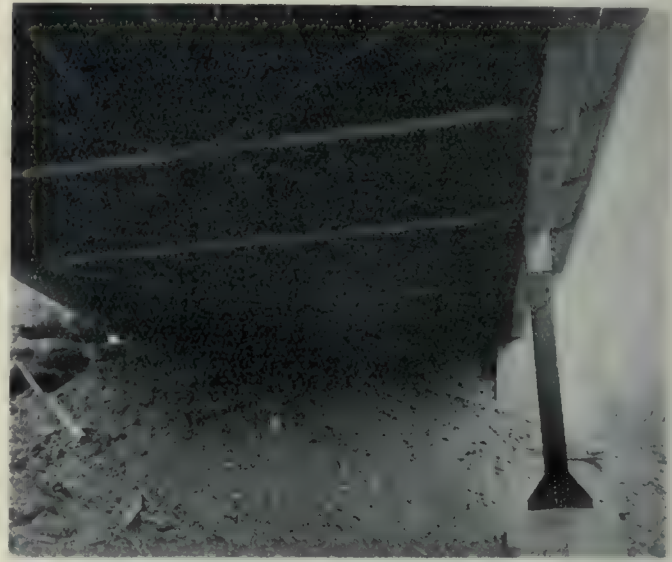


Fig. 3. Floor beams, lateral bracing, etc., are completely coated with gunite.

Article Did Injustice to Cube Concrete Mixers

Editor Contract Record:—

We are sure you will appreciate our calling your attention to a mis-statement of fact in your issue of Contract Record dated Dec. 21st last. In the article entitled "How to Select, Install and Operate a Concrete Mixer" under the sub-heading "Revolving Machines" there appears a sentence reading as follows:—"In some types the machine is both charged and discharged while in revolution, and in others as in the cube, it must be stopped to receive the material and discharge the concrete."

As cube mixers are not, and never have been made by any other Company than the Austin Co., our authority will hardly be questioned when we say that the cube does not have to be stopped either to receive the material or to discharge the concrete. Not only would that statement be untrue with respect to any model of cube we have ever made, but we may go further and say that to the best of our knowledge, no owner of a cube makes a practice of stopping its revolution for either purpose. If for any reason it were desirable for him to do so, he could with perfect safety charge the cube when not revolving and discharge from it when stopped, which is more than can be said of any type of drum mixer that we know of. But ordinarily there can be no object in doing so because the machine functions better when the revolution is continued.

The writer of the article apparently had some acquaintance with cube mixers for he excepted them from the class that were "equipped with fixed or movable interior blades". Those contrivances are necessary in the drum type; without them neither mixing nor discharging would be possible. Not so, however, with the cube, as you may better understand from the following description of its operation.

Picture a perfect cube, journalled at diagonally opposite corners. Then imagine the cube revolving on an axis passing through these corners. You will note the zigzag travel of the "centre line" when the cube revolves, and you will realize that a batch of concrete inside of the cube will be caught alternately in these zigzag corners, this action resulting in the folding of the upper portion of the mass over upon itself with considerable force, the direction of travel being always toward and past the centre. Since only two of the eight corners are used for journals, six remain for the mixing and kneading operation. This folding and amalgamating process occurs from 96 to 120 times per minute when the cube revolves at the standard rate of 16 to 20 times per minute. Under this process the materials undergo such a thorough mixing that excellent concrete can be turned out in from 30 to 60 seconds from the time the batch enters the cube until it is discharged.

Interior blades of any kind are bound to operate to at least some extent as an obstruction both to the flow of materials in, and to the flow of concrete out. The cube is entirely free of any such obstruction, hence the advantage we claim it possesses over other types in the rapidity with which it will charge and discharge.

Yours very truly,
Canadian Austin Machinery Ltd.
per A. S. Robertson

Annual Meeting, Toronto Contractors

The Builders' Exchange Decide to Inaugurate a Publicity Campaign to Acquaint the Public with Conditions in the Industry—Good Year Expected

At the annual meeting of theToronto Builders' Exchange and Construction Industries held on Tuesday, January 10, it was decided to launch an advertising campaign with the object of acquainting the public at large with the true situation in the construction industries at the present time. The trend of this publicity campaign will be to indicate to owners and investors that building costs have receded sufficiently far to warrant a resumption of activity. By this method the Exchange was inclined to give support to those sections which are having labour troubles at the present time. It was felt by the members at the meeting that the public was not sufficiently acquainted with the situation to understand that labour's demands are unwarranted and entirely beyond reason. For that reason the Exchange approved of a resolution which read, "That we place before the public an advertising campaign showing extreme rates of wages and those labour agreements which contain restrictions which are costly to the public." It is fully expected that when prospective builders are acquainted with the truth of the matter, they will give their moral support to the Exchange in its efforts to reduce the cost of construction and stimulate activity. Mr. Gander, secretary of the Exchange, explained that this publicity matter would cover conditions over the entire continent and indicate how labour is insisting on clauses in its agreements which restrict the number of apprentices taking up the trade. It was further explained that it is not the intention of the Exchange to be antagonistic to labour but to give a true picture of conditions as they exist at the present time.

Meetings with Labour

The past year's work was briefly summarized in the annual report of the retiring president, Mr. J. M. Scott. Mr. Scott outlined the relations which the Exchange had had with labour during 1921. In part, he reported as follows. "Important meetings were held with the labour people, one of which was a meeting in Ottawa in May, at which seventy-three representatives of both employers and employees connected with the building industry convened to discuss their mutual problems. In July, a meeting of all trades and organizations interested in the industry took place at the instigation of the Canadian Manufacturers Association. This was followed by a meeting in the Exchange attended by thirty-seven representatives, gathered for the sole purpose of trying to bring about a general reduction in building costs in order to stimulate the trade. Labour rejected every proposition presented at these meetings, even in the face of the Minister of Labour's address wherein he warned them that the time had come for serious consideration of the wage reduction question. In spite of this appeal they turned a deaf ear.

"The wages of stone cutters, carpenters, lathers and labourers were reduced during the year. The other trades are still high, but we trust that they will be so settled as to make the public and the investor feel satisfied that they will receive a fair rate for their investment."

Mr. Scott claimed that the public will be the sole arbiter on the matter of prices in the building trade and was convinced that lower prices had to prevail.

Cost of Materials Dropped

"The cost of material," further declared Mr. Scott, "has decreased considerably during the latter part of the year. Had wages and material been easier earlier in the sason, I feel sure that more work would have been inaugurated." Mr. Scott looked for further relief from both high wages and costly material. In conclusion, he commented on the fact that no serious inconveniences had been experienced during the year and that while work has been somewhat scattered, it has been satisfactory enough in volume to keep labour fairly well employed.

The secretary, Mr. George Gander, in presenting his annual report, reviewed the activities of the Exchange in connection with legislative, educational, compensation and joint industrial council matters. Extracts from his report are as follows:

"With the City Council we had two meetings protesting against day labour and a sixty cent rate for unskilled labour. While nothing of a definite nature has resulted, we feel that the council knows that the tax payers are against these extreme payments for that class of labour.

"We objected to the Eight Hour Day and Fair Rental Bills both submitted to the Legislature. We also strongly objected to the proposed new Lien Act, as we felt that in the form submitted, it was detrimental to contractors and imposed restrictions on the building industry.

We have had several meetings with the Board of Education to consider some changes in the relationship between that Board and our Exchange. The Board seems inclined to listen to the complaints of labour and does not find out what is the prevailing rate of wages. We thank the School Board for extending time on tenders and for their generosity in loaning sets of plans for the use of our members.

"There is a request from this Exchange for representation on the Advisory Board for Technical Education. The work of this board is of direct interest to this organization and it should take the opportunity of voicing its opinions on the matter of technical education.

"We have been approached by the Federal Government officer to try and place the Industrial Advisory Council once more on its feet. It is my feeling, however, that unless labour can give us a guarantee to keep its agreements, very little can be gained. Labour claims that the wage question is the only object in making an agreement, and as the Joint Industrial Council does not seem to have any sure control over this element, we contend considerable time is lost in talking over less important matters.

Convince the Public to Build

"The season is now on when we should prepare for action and nothing should stand in the way of our convincing the public that now is the time to build. Prices are as near rock bottom as possible and we should have no difficulty in convincing the architect and owner to place their plans on the table at once. Many expensive building projects were laid aside during 1919 and 1920, and office and house building is far behind the needs of to-day. It would be better that these projects be started at once to avoid an unseemly rush later on with the resultant delay in delivery of material. We note with pleasure that during the past year, no building proposition has been abandoned on account of too high prices. The reverse has been the case and every job has been well within the architect's estimate.

"Competition is keen and I would not like to say that we are making money, but I do feel that we are holding our own and doing even better than some classes of business. The prices of 1914 must be forgotten. We can hardly revert to them while the Government and other taxes, caused by the war, have to be met."

Following the presentation of these reports, general business was proceeded with, one matter that took up considerable attention being the question of fees. After discussion of this point, a resolution to make the minimum fee $30.00 instead of $25.00 was carried, and in addition, a committee to report on an increase in membership and on a rearrangement of fees was approved. The question of allying themselves once more with the Joint Industrial Council was left over until the Association of Canadian Building and Construction Industries had intimated its stand on this matter at the Hamilton Construction Conference.

The Exchange took an opportunity to protest against the sixty cent minimum wage for common labour pertaining to all civic work, and it was decided to send a deputation to the City Hall. A protest was also made against the inactivity of the labour section of the Unemployment Board appointed by the Ontario Government.

New Officers

The report of the Nominating Committee and the list of officers therein recommended were adopted unanimously. The following are the officers for 1922: President—W. H. Painter; vice-presidents—Messrs. Carmichael and John V. Gray; directors—Messrs. J. M. Scott, C. F. Till, Edward Teagle, J. J. Brown and W. A. Bulley.

It was decided that some expression of appreciation should be shown Mr. C. F. Till in recognition of his services as secretary of the financial committee and auditor of the books of the Exchange.

Niagara Falls, Ont., Is Taking Up Town Planning

Mr. Horace L Seymour, C.E. (Tor.), A. M. E. I.C., town planning engineer, of the firm of Frank Barber and Associates, Limited, consulting engineers, Toronto, has been retained as city planning consultant to the city of Niagara Falls, Canada. The first work will be that of consulting with the city engineer, Mr J. C. Gardner, B. A. Sc., A. M. E. I. C., in the preparation of study maps and data. This information will form the basis of zoning maps and proposed zoning ordinances, as well as for other features of a city planning scheme.

In Ontario cities but little has been accomplished in comprehensive city planning. Some Canadian cities have taken advantage in the past of the assistance furnished by the Commission of Conservation with Mr. Thomas Adams as town planning advisor. The time has come when each city must plan for itself and the city of Niagara Falls is one of the few in Ontario who are taking their zoning and city planning problems seriously. The advantages of city planning are evident and it is hoped that more Canadian municipalities will follow the excellent example furnished them by the city of Niagara Falls.

Work of U. S. Reclamation Service

According to the annual report of Director Arthur F. Davis of the U. S. Reclamation Service, 2,845,000 acres were irrigated during the year, of which 1,662,000 acres depended solely on federal water supply. The crops from this acreage netted the farmers $66,300,000 while in the areas which the government aided in irrigating, the crops were valued at $47,500,000

First Unit of Chippawa-Queenston Power Scheme Officially Placed in Operation

December 28, 1921, a Red Letter Day for the Engineers of the Hydro-Electric Power Commission of Ontario—Hundreds of Municipal Representatives in Attendance—The Largest Hydro-Electric Unit in the World Successfully Installed and Operated

From many view points the official opening of the Chippawa—Queenston hydro-electric generating plant on December 28th last, marks an epoch in Canadian history.

To begin with, it is a colossal enterprise, the ultimate success of which must have caused the engineers, who were charged with the responsibility, many anxious months.

As finally planned this development is the largest hydro-electric scheme in the world, utilizes the largest capacity units, and represents more pioneer work of a kind for which there was no precedent to act as a guidance.

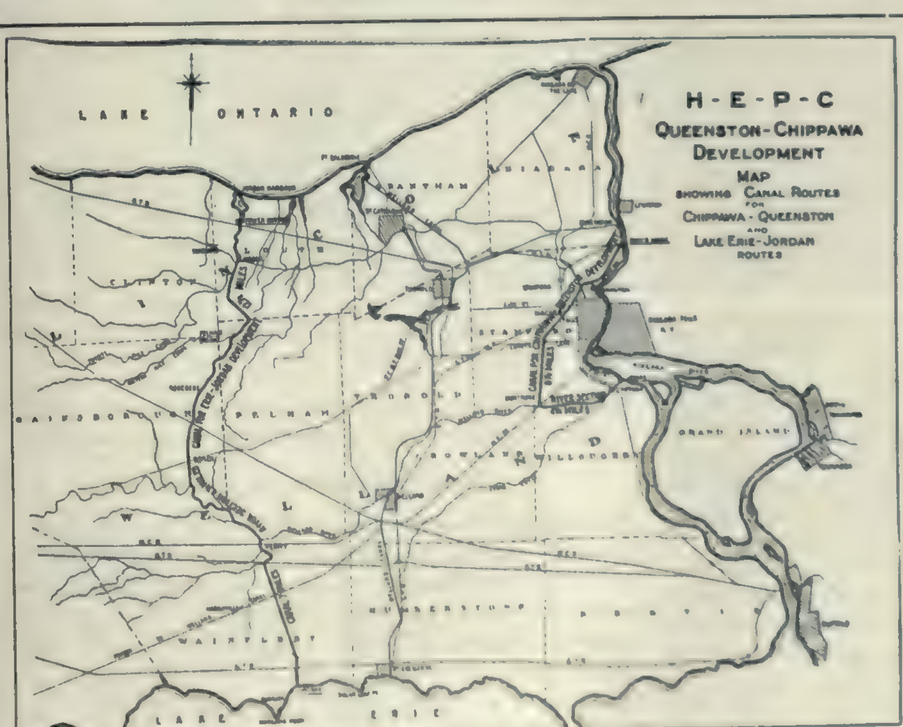
Of even more significance, however, than the size of development adopted, the full natural force of Niagara's power is brought under control for the use of man. Other and earlier developments at Niagara had not attempted this ideal, and Canada's engineers must be given all credit for the courage that enabled them to grapple with and solve a problem upon the solution of which so much depended.

To the citizens of the province, it is most important to know that this natural resource is being utilized to the fullest extent and that all the benefits of this great natural heritage will accrue, either directly or indirectly, to every man, woman and child within electrical transmission distance of this great power centre.

Inasmuch as the official opening marks the completion of the civil and mechanical sections of the work, a general review of the whole project seems to be justified. If in the pages that follow we repeat certain information that has already been published in the Contract Record, it is because we desire that the present issue should constitute a complete history of this greatest of hydro-electric projects.

Selecting the Proper Location[*]

From the combined viewpoint of conservation and ultimate economy, the ideal Niagara development would be one that would utilize the whole of the future available water under the gross head of 327 ft. existing between Lake Erie and Lake Ontario. Several schemes, approximating



This map shows the relative positions and lengths of the Erie-Jordan and the Chippawa-Queenston canals.

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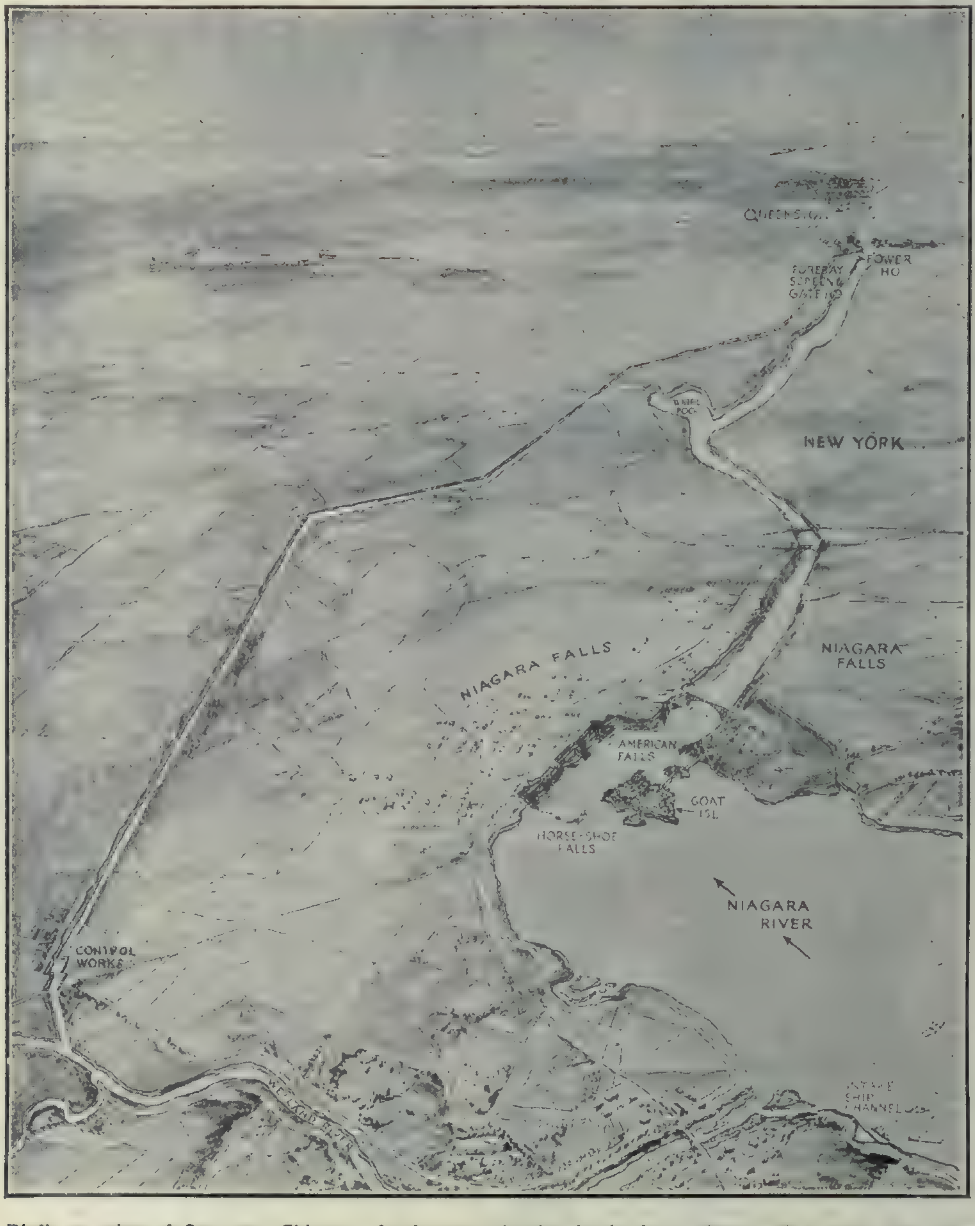
[*] Harry G. Acres, Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario.

this ideal in varying degree had been advanced during the last 20 years, the most practicable and promising of which was known as the Jordan-Erie scheme. This involved the intaking of water near Morgan's Point on Lake Erie, the building of an open waterway across the Niagara Peninsula to the brink of the escarpment above Jordan Harbour, thence carrying the water to the power-house at Lake Ontario level through a mile of pipe. Studied from an engineering standpoint, this scheme was open to serious objection for three main reasons, first, the unavoidable intake conditions at Lake Erie; second, the structural difficulties and unavoidable head loss in connection with the 24-mile canal; and the third the regulation difficulties attendant upon the control of a mile long water column in the penstock connection between the head of the canal and the power-house, where something over 16 feet of penstock would be necessary for each foot of effective head.. The economic effective head for this scheme worked out slightly less than 300 feet, the bulk of the losses being, of course, taken up in the long canal.

The problem was, therefore, to find some feasible location that would overcome objections to the Jordan-Erie scheme. During the course of the subsequent investigations, it developed that by far the best intake conditions would be obtained at the mouth of the Welland River at Chippawa; also that suitable power-house locations were obtainable in the gorge between Foster's Flats and Queenston, which would require only about 18 inches of penstock connection for each foot of effective head, thus reducing the regulation problem to one of minor importance.



Bird's eye view of Queenston-Chippawa development showing intake from Niagara River above the Falls with Welland River section in foreground leading water to control works at upper end of canal which stretches to power house at Queenston where water is returned to the lower Niagara River.

Pressure Canal versus Open Canal

Having tentatively solved the intake and regulation problems, it remained to determine whether or not it was feasible to construct a suitable waterway between the Chipawa intake and the power-house location above Queenston. An exhaustive series of surveys and core-drill borings established the fact that it would be entirely feasible to connect these two points by either the open canal or the pressure tunnel type of waterway. The next problem was to determine which of these two types of waterway would be the more suitable from the combined viewpoint of pure hydraulics, structural difficulties and hazards, and comparative cost.

In the matter of comparative cost, carefully compiled estimates indicated that throughout the full range of assumed carrying capacities, the open canal had a decided advantage over the pressure tunnel.

Pressure Tunnel Disadvantages

In the matter of structural difficulties and hazards the following main points were given consideration in the case of the pressure tunnel:—

(a) The necessity of driving the headings at an acute augle through the various limestone, shale and sand-stone formations, involving the certainity of a heavy overbreak and expensive timbering and lining.

(b) The unfavorable conditions as regards the disposal of excavated material.

(c) The unknown water hazard and the impossibility of predicting the cost of unwatering within reasonable limits of accuracy.

(d) The difficulty and hazard attending the driving of, and maintaining a pressure tunnel of unprecedently large diameter in the clay formation of the Whirlpool Ravine.

(e) The difficulty in connection with the construction of a distributing chamber in the shale and sandstone at Queenston.

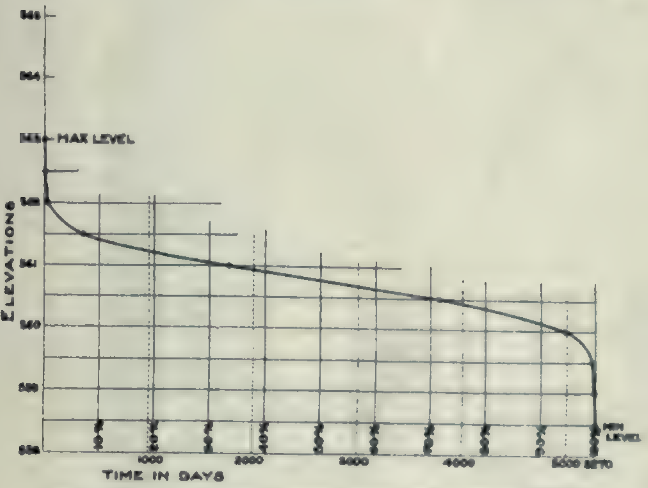


Fig. 1 Duration curve of water levels at Chippawa, 1902-16

As against the above, the difficulties and hazards in the case of the open canal were limited to two main points; first, the removal of the earth overburden in the canal prism, and second, the permanent holding of the slopes subsequent to such removal. While it may never be possible to establish finally the comparative importance of the above points on the basis of actual construction, the fact remains that the work on the open canal has demonstrated beyond doubt that the overburden can be removed with no more difficulty than was anticipated and that the means orginally devised will hold the banks safely within the limits of the predetermined slopes.

Hydraulic Comparison

In the matter of purely hydraulic comparisons, the first point to consider is that both types of waterway would, of necessity, have the same point of intake at Chippawa and the same point of discharge at Queenston, so that they are exactly on a par as regards the utilization of available gross head, neither having any primary advantage over the other in this regard.

Since 1902 the water level at Chippawa has been observed and recorded twice daily. Fig. 1 shows the mean daily elevations for the ensuing period compiled in the form of a duration curve. The following facts are deducible from this curve.

(a) The mean level for the entire period is about elevation 560.8.

(b) A level of elevation 559.5 or higher is obtained for nearly 99 per cent. of the entire period.

(c) A level of elevation 561 or higher is obtained for a little more than one-third of the above period.

(d) It is reasonable to assume that the effective operating range of levels lies between elevations 559.5 and 561.

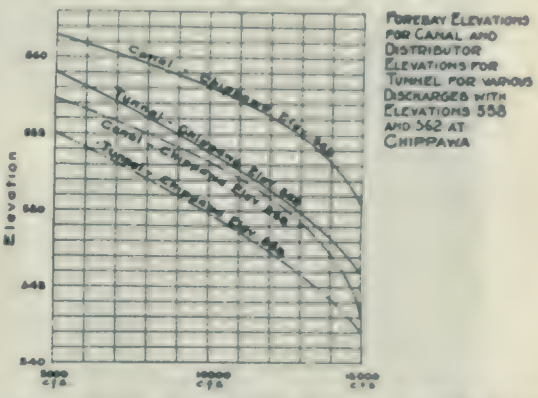


Fig. 2. Comparison of head losses chargeable to tunnel and canal waterways

As to the possibility of the carrying capacity of either type of waterway being seriously affected by a permanent lowering of the natural levels of the Chippawa-Grass Island pool, due to present and future diversions of water therefrom, it is essential to consider two facts; first that any diversion for power purposes from the pool itself will be largely compensated for by the intercepting effect of the diversion works, and second, that the level of the pool can be controlled independently to compensate for any diversion whatever, whether from the pool itself, from the upper reaches of the river, or from Lake Erie direct.

Fig. 2 shows in graphic form a comparison of the head losses chargeable to each type of waterway under discussion. In making this comparison, a possible extreme low elevation of 558 has been assumed for head-water, and the open canal losses calculated on this basis for a carrying capacity of 15,000 sec. ft. On the basis of this loss a tunnel was designed of the requisite diameter for the same capacity of 15, 000 sec. ft.

These curves have been computed for the extreme range of possible operating levels, elevations 558 minimum and 561 maximum. The shape of these two pairs of curves illustrates clearly the basic difference between the two types of waterway. Under the assumed conditions the tunnel and canal curves for the head-water elevation 558 and 15,000 sec ft discharge have a common point of origin. As the discharge drops off, however, it is seen that the canal delivers any

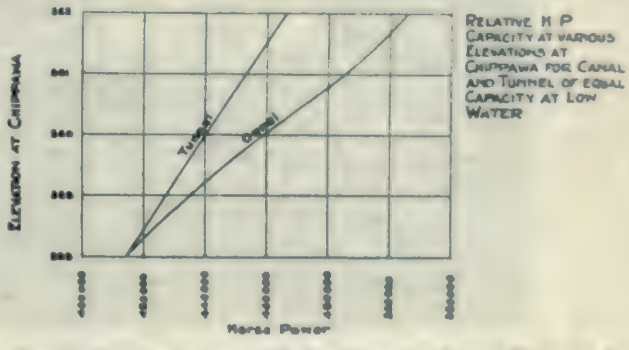
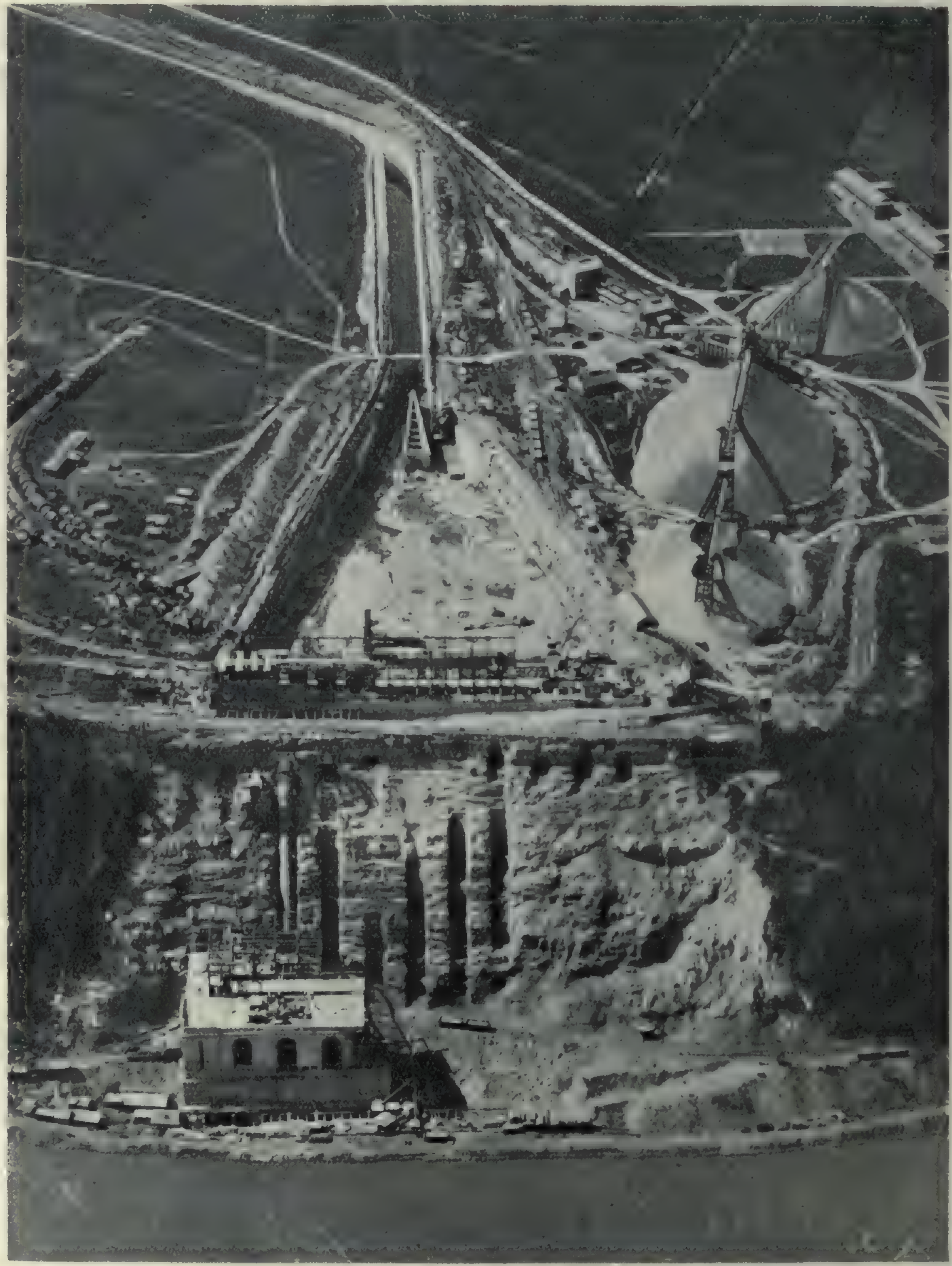


Fig. 3. Relative h p. capacity at various elevations at Chippawa for canal and tunnel

Airplane View of World's Largest Power Scheme



A wonderfully realistic Bird's-eye view of the Chippawa-Queenston development of the Hydro-Electric Power Commission of Ontario showing Canal, diffuser, forebay, gatehouse, penstocks, powerhouse and Niagara River.

fixed discharge to the forebay at a consistently higher elevation than in the case of the tunnel. This is simply due to the inherent characteristics of the two types of waterway In the case of the pressure tunnel, the discharge area is necessarily constant and any gain in head is due to decreased friction only. In the case of the canal the reduction in velocity not only reduces the friction losses, but the retardation of flow increases the effective discharge area of the canal section. By reason of this extra factor, the open canal has an advantage over the tunnel ranging as high as 5 feet of head loss. When the high discharges involved in the problem are considered, it is evident that this difference in head loss is a very important factor.

The curves shown on Fig. 3 have been plotted on a different basis, but with the same factors involved. In Fig. 2 head-water level and carrying capacity have been assumed constant and forebay level the variable. In Fig. 3 head-water and forebay level are the constants and carrying capacity expressed in horsepower is the variable. In this latter curve forebay level is assumed constant at the fixed minimum elevation for peak load capacity and from this common point the comparative carrying capacities for the two types of waterway have been calculated for specified levels of head water in the Chippawa-Grass Island Pool.

Typical section of completed canal through deep rock cut, showing smooth concrete lining in lower portion

The conclusions which may justifiably be drawn from the above discussion are; first, that starting from the common basis of equal loss and carrying capacity at extreme minimum head-water level, the open canal will deliver the required quantity of water to the forebay with a materially less loss of head than the pressure tunnel, for any head-water level above the assumed absolute minimum; second, that starting from the common basis of a fixed minimum forebay level, the canal will deliver a constantly increasing quantity of power in proportion as the level of the head-water rises above the assumed extreme minimum level, which the pressure tunnel cannot do to any appreciable extent by reason of its inherent hydraulic characteristics; and finally, that the open canal is the only agency, under the above conditions, which can make automatically available the large quanities of excess power resulting from any temorary or permanent increase in the level of the Chippawa-Grass Island Pool, above the extreme minimum level which has been used as a basis of comparison

The above were the primary reasons which led to the final choice of the open canal for the connecting waterway between Queenston and Chippawa. This canal, consists of 4¼ miles of the improved natural channel of the Welland River near Montrose to the forebay site above Queenston. Besides being only about half the length of the alternative Jordan-Erie Canal, the average operating head for equal qualities of water carried is about six feet greater at Queenston than it would have been at Jordan Harbour, despite the fact that the elevation at the point of intake is about 9 feet lower and the elevation at the point of discharge about 2 feet higher, than would have been the case with the Jordan project.

Another distinct advantage of the open canal is the fact it can effectively and inexpensively take advantage of any water which might now or in the future be available from the Welland Canal system. This open waterway would furthermore furnish the only means, in connection with the upper reaches of the Welland River of reclaiming the unused 9 feet of head in the Niagara River above Chippawa.

The Queenston-Chippawa development in its final form is a much larger installation than that contemplated in 1915, when under the exigencies of war conditions, it was proposed to construct a power development and canal with an initial capacity of only 100,000 horse power, and an ultimate capacity of 190,000 horse power at a cost for the initial development of $10,500,000—a figure, which it has been computed would have been raised to approximately $29,000,000, due to war prices prevailing during the years 1918, 1919, 1920 and 1921.

The Design of the Canal *

The canal is divided into four sections. The first of these is the Welland River section 21,000 feet in length, with a bottom slope 0.000119 and side slopes of 2 to 1. This was excavated by means of dipper dredge and cableway. The earth section which follows the river section is 6,250 feet long with a bottom slope of 0.0001208 and is rip-rap lined with finished side slopes of 1.5 to 1. For each of these sections a roughness factor of .035 in Kutter's formula was used. The earth section of the canal was orginally designed as a concrete lined section of much smaller cross-sectional area but a study of the economic, constructional and operating conditions indicated that the advantages of the larger section with the rip-rap lining would be sufficient to compensate for the cost of the extra excavation. This portion of the canal has a capacity of over 15,000 c. f. s. with uniform flow at the assumed roughness factor of 0.035, and extreme low water in the Niagara River at Chippawa.

At the end of the earth section is located a transition, 300 feet long, in which the trapezoidal cross-section is changed to the rectangular rock section of 48 feet finished width with concrete sides and bottom. Beyond this are the control works, which are described later

The rock section proper is 36,252 feet long and is divided into two parts by the Whirlpool section which has a length including transition, of 2,450 feet. The water section of the rock portion of the canal has concrete lined sides and bottom with a finished width of 48 feet. The bottom slope is 0.0002113 and the roughness factor used in Kutter's formula 0.014. This value is conservative in view of the method of placing the concrete lining. With the steel forms that were used and the special provisions made for alignment of the forms, a smooth plane surface was obtained on the concrete facing.

For 13,500 feet the concrete lining is carried up 32 feet above the finished grade of the canal; for the next 11,500 feet the lining is 31 feet high and for the remainder 30 feet high, except in the Whirlpool Section where it is carried up to elevation 563.0 For the greater part of the time the water surface will be above the top of this concrete lining but the friction loss will be reduced by the lower velocities that will then exist in spite of the greater roughness of the unlined rock. Numerous hydraulic studies have been made to determine the surface slopes in the canal for various discharges and for various water levels in the Niagara River. In cases where the water surface was above the top of the concrete lining a composite roughness factor was used in which the proportions of the wetted perimeter on the lining and on the rock surface were taken into account. Roughness factors as high as 0.019 resulted in some of these instances.

Determination of Depth and Slope

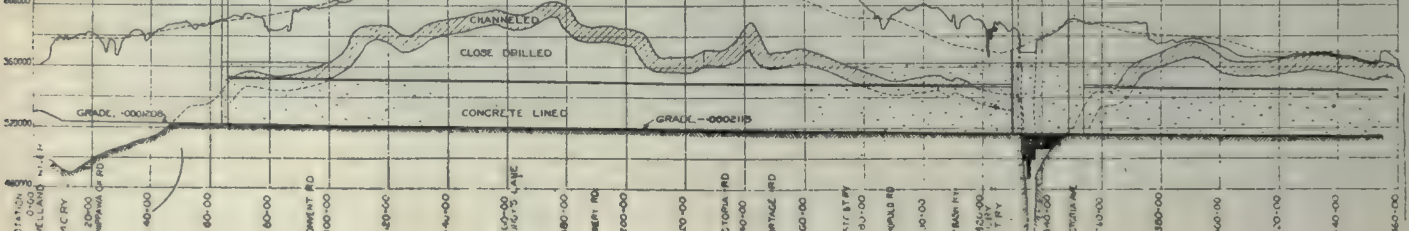
The depth and slope of the rock section were fixed by an economy study and the decision to use a concrete lining throughout its length was also reached in the same way. The method of arriving at the economic section of the canal will be explained later.

An examination of the profile of the canal indicates that the rock surface falls far below the grade of the canal about Sta. 333, rising again to grade about Sta. 349. This occurs in the Whirlpool Section, which is located at Bowman's Ravine or the Whirlpool Gully. Here it was necessary to carry the canal partly on fill and to use a trapezoidal cross-section on account of the foundation upon which the canal is carried. A concrete lining was essential on account of the high velocities. The bottom width is 10 feet and the side slopes 1½ to 1. The slope of the bottom is the same as that of the rock section, viz., 0.0002113.

The Whirlpool section of the canal was designed to have the same cross-sectional area at the lowest possible operating water level as that of the rectangular rock section. This minimum water level would be somewhat above elevation 542, which is the elevation of the curtain wall at the screen house. The area of the cross-section below elevation 542 is the same for both and for greater elevations the Whirlpool section has the greater area so that there is no danger of the canal capacity being "choked off" at this point.

In locating the Welland River section the river course was followed closely so as to take advantage of the area of the natural channel. This necessitated leaving in all the bends that occurred in the unimproved stream. As the deflection of these curves is not great they will not produce any appreciable loss.

The first important change in direction occurs at the beginning of the earth section at Montrose and is followed by a second bend at the Michigan Central Railroad crossing at Montrose. In addition to these there are only five changes of direction in the rock section of the canal, the deflections of which are 51, 27, 31, 33 and 46 degrees. The radius of curvature in every case is 300 feet and this radius is used for the inside and outside of the bend as well as for the centre line. That is, the curves of the two sides and the centre line of the canal are not concentric, resulting in a greater width of canal at the middle of the bend than at either end, the expectation being that the energy losses will be less than in a bend with concentric curves. It is probable that a shorter radius than 300 feet would give even better results, but this



Profile of Queenston-Chippawa power canal, exclusive of river section

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* T. H. Hogg, Assistant Hydraulic Engineer, Hydro-Electric Power Commission of Ontario

minimum was fixed by the size of the electric shovels that are being used for the excavation work.

The question of surges of the water surface in the canal, due to changes of load on the plant, is of great importance. This problem received an amount of study proportionate to its importance. The sides of the canal and the floor of the screen house will be built to such an elevation that with the worst combination of conditions the water will always be contained within the sides of the canal.

Observations of river stage at Chippawa have been available since 1902 and show a minimum W. S. elevation of 558.5, which low stage was reached only on two days. An examination of the past records of Lake Erie stage indicate that as low a stage as 558.0 may be possible at Chippawa. This latter water level is therefore treated as extreme low water and the canal is designed to carry full load at this stage of the river.

While the low water conditions control the size and slopes of the canal, on the other hand the mean water conditions were assumed to be those on which the economic proportions should be based.

Design of Canal Section

Certain limitations were met with at the outset. The Welland River section of the canal had to be maintained as a navigable stream, and as the excavation is in earth this portion of the canal was therefore designed for a low non scouring velocity. The minimum width of the rock section was fixed by the type of electric shovel used for excavating this portion of the canal and was placed at 48 feet.

The problem thus resolved itself into selecting the best proportions for the trapezoidal earth section and the best depth and slope for the 48 foot rock section. The procedure in the latter case is the one that will be described.

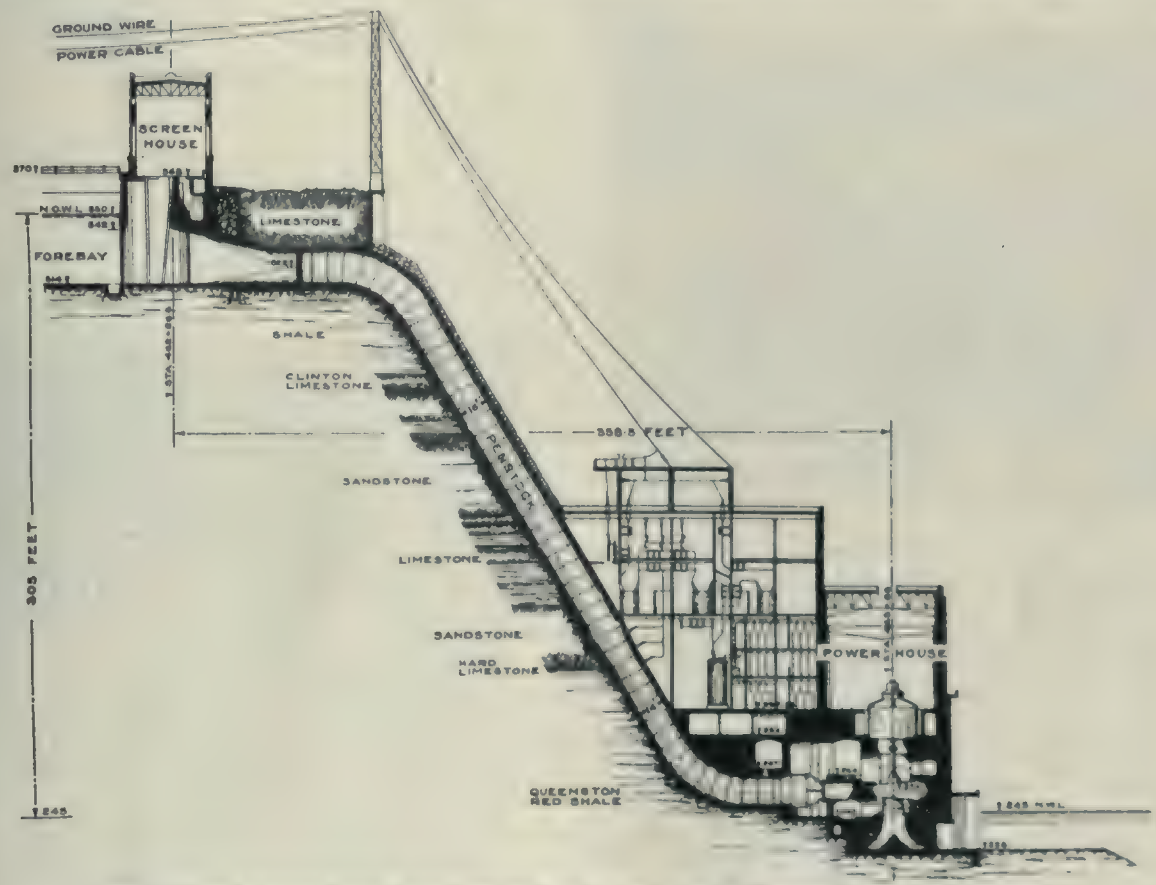
It is, of course, possible to design any number of canals 48 feet wide, but with depth and slope varying so that all will give the same discharge at low water. For a low velocity the wetted cross-section must be deep but its slope may be moderate. For a high velocity the depth of the wetted cross-section will be small but the slope may be so great that the depth of the cut at the down-stream end may be greater and the total cost of excavating greater than for the low velocity design.

The procedure in determining the economic depth was as follows:

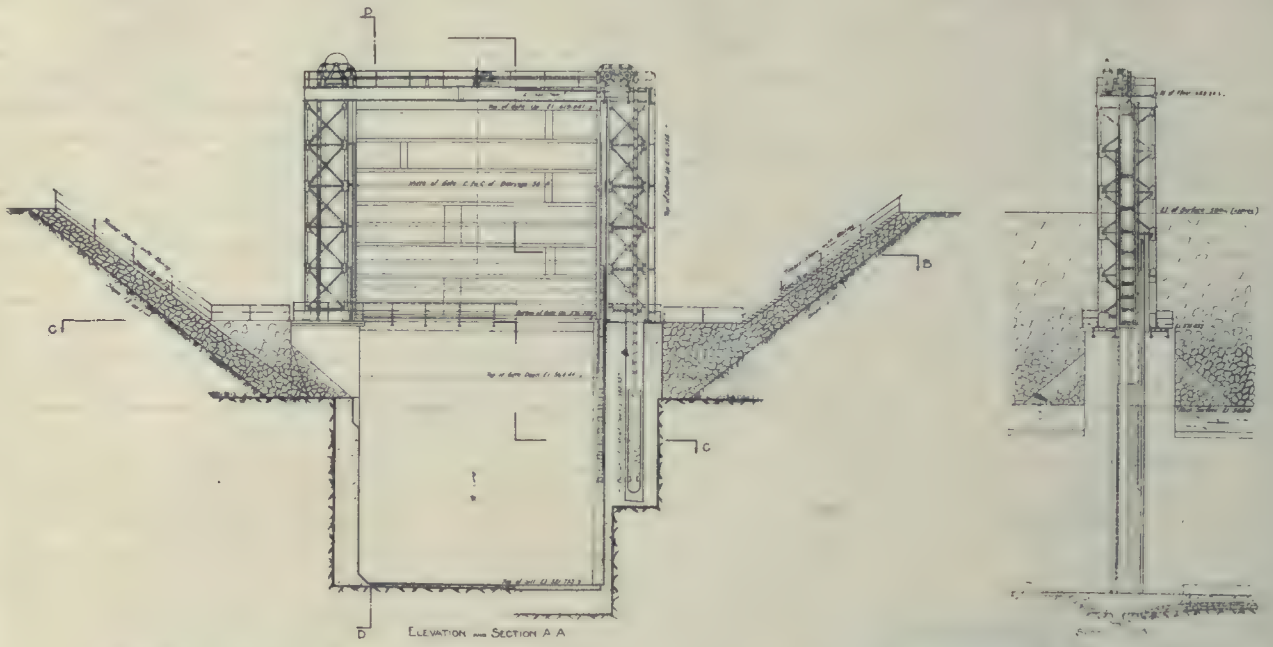
First, the design of a number of cross sections for velocities of 3, 4, 5, etc., feet per second, the determination of the requisite slope of the bed in each case to give the full load discharge with uniform flow, and the determination of the variation in cost of these canals with low water velocity.

Second, the determination of the friction loss in each of these canals with the river stage at its mean value. This friction loss represented so much lost power, which was, of course, small in amount for the lesser low water velocities, and greater as the low water velocity increased up to a certain point.

Third, the plotting of the differential curves for items 1 and 2 thus showing the variation in delta cost with low water velocity and the variation in delta power with low water velocity. From these two differential curves a third curve can thus be obtained giving the value of delta-cost by



General section through screen house, penstocks and power house of Chippawa Queenston development



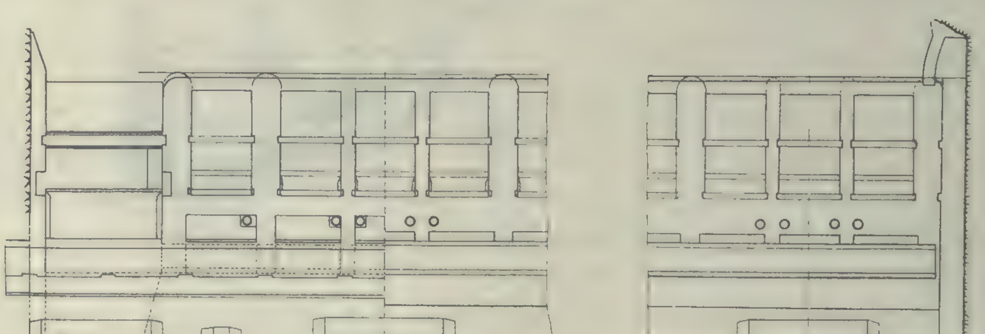
Elevation and Section main control gate, located in rock section of canal near its junction with Chippawa creek

delta-power plotted against low-water velocity. Thus there is obtained what will be called an economy curve, showing for any given low water velocity, the rate at which further gains in power may be made at any low water velocity by enlarging the canal slightly and so cutting down velocity and friction loss.

Fourth, the selection of the best low water velocity from this economy curve.

Economic Water Velocity

The gain in power which results from a slight enlargement of the canal comes as a result of the reduction in friction loss. The additional cost for power house equipment is so small, within the limits in which we are working that they can be neglected. It is reasonable then to continue the enlargement of the canal until the interest charges on the cost of excavation for the last horse power gained are equal to the average value of the power from the whole plant, including interest, depreciation, operation and maintenance. By stopping short of this point we would be in a position to gain more power at a cost less than the average that we were



Sections through intake to penstocks—Note triple openings and double gate protection willing to pay for the power from the whole plant. It is interesting to note that the economic velocity determined in this way is but slightly larger than the minimum cost at which the canal could be built to get the required discharge at low water. The minimum cost occurs for a velocity somewhat greater than the economic velocity.

The advantage for this method of attack is that it permits an economic size to be selected for the canal without the inclusion in the estimate of the cost of anything that does not vary with the low water velocity. In this case, the width of the rock cut being fixed, the earth excavation does not vary with the various designs for the rock section and as a matter of fact in computing the cost of rock excavation only that below some assumed horizontal plane at a lower elevation than natural rock surface but above canal grade was considered.

Details of Hydraulic Installation*

Before dealing with the constructional details of the canal and power house, we shall treat briefly a few of the outstanding features in the hydraulic installation. The features to be touched upon cover the canal control gate, mentioned already as being situated within a few hundred feet of the point where the canal proper joins with the Chippawa River; the intake; ice chutes; screens; removable gates; penstocks; Johnson valves; turbines; governors, etc.

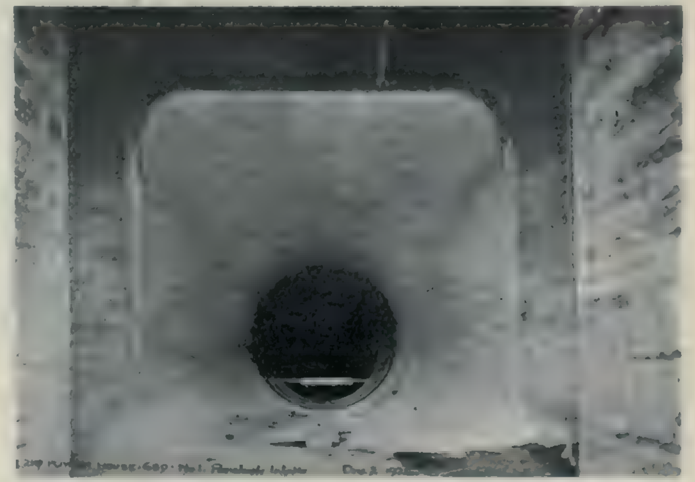
View of penstock mouth from one of the three openings

The Intake

The Commission has found it necessary to delay work on the intake to enable them to concentrate on other portions of the construction work. This was possible on account of the limited demand that will be made upon the water supply from Niagara River during the present winter. When completed, this intake will be of special design to take care of ice trouble. The design has been determined by a long series of tests and experiments with models. It is probably sufficient to say that at the moment the engineers believe the design they have adopted, will permanently remove the ice troubles which have caused a number of the power houses at Niagara Falls so much trouble in the past. In the meantime, water to operate the plant enters the Welland River through a natural channel which will eventually be closed when the permanent intake works have been installed.

Canal Control Gate

A single motor-operated vertical lift roller gate for the purpose of controlling or entirely shutting off the flow is installed at the upper end of the canal near Montrose where the earth section of the canal merges into the rock section.



Close-up view of penstock mouth

The combination of span and head make this gate the largest ever built and particular attention was paid to the roller design in order to secure bearing loads well within safe, structural and operating limits. The clear width is 48 feet and the height of the gate is 42½ feet.

The general arrangement of the control gate is shown. It will be noted that the lift is extended to a point 14 feet above the water level and this has been done in order to permit a patrol tug to pass freely up and down the canal when the gate is in normal position, i. e., wide open.

The gate is counterweighted and operated by a motor connected through a worm drive to the two main hoisting gears, and the motor is provided with distant as well as local control so that the gate can be operated from the power house if required.

The gate itself is made up with horizontal trusses spanning the opening and vertical beams to which the skin plate will be rivetted. It is not important that the gate be absolutely watertight when closed although "stanching" bars are provided to insert between the skin plate and the end guides which make it practically tight.

A comparative analysis of costs and operating conditions was made on the single gate as against two gates with an intermediate pier, and it was found that the cost of a single gate and superstructure did not exceed the cost of the twin gates, on account of the additional construction required by the intermediate pier and the necessary widening of the canal to keep down the velocity to normal. When the added advantage of having a clear unobstructed waterway was taken into account as well as the simplified operation of a

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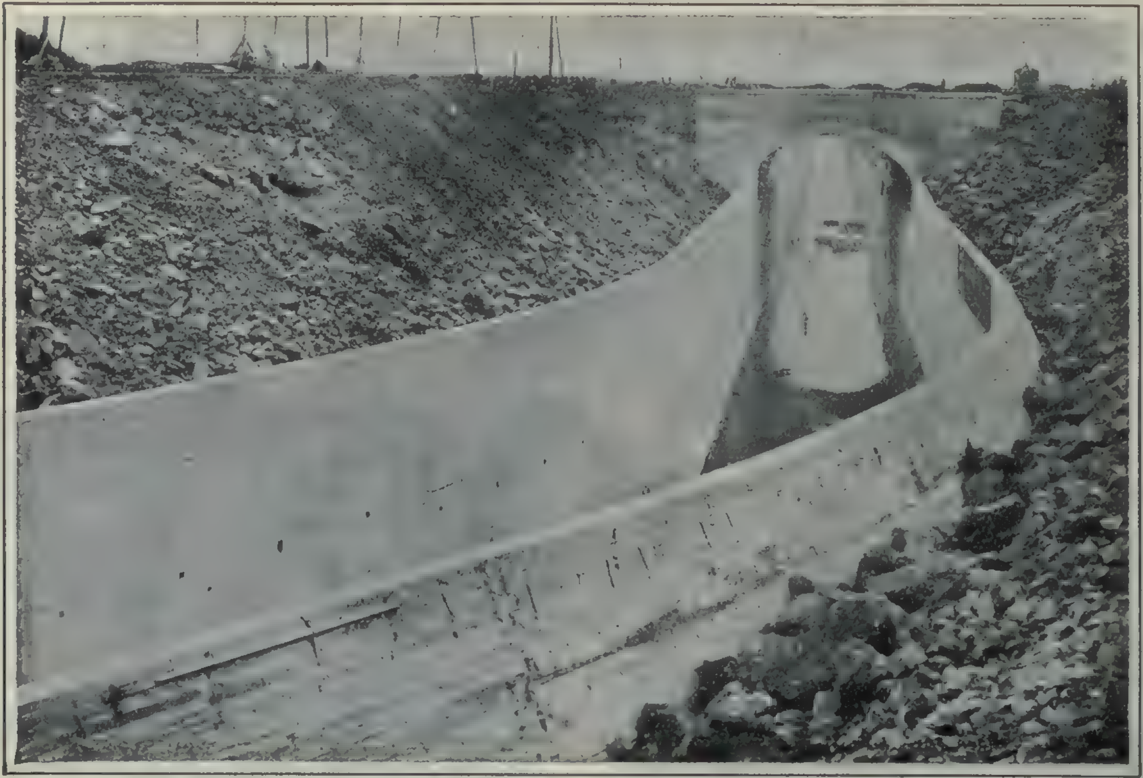
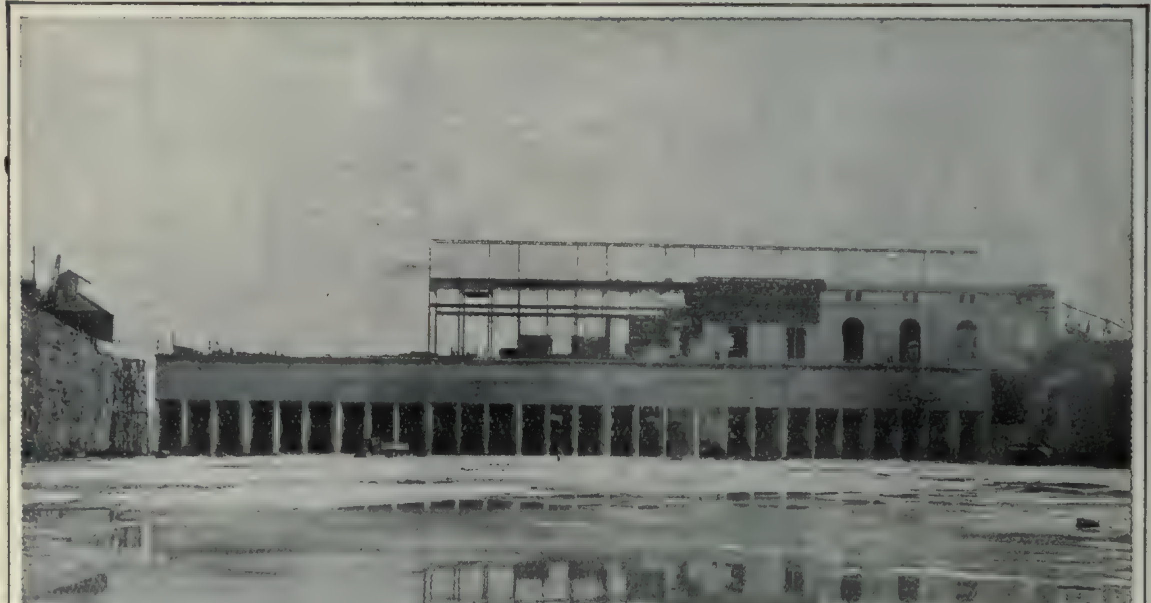
* M. V. Sauer, Assistant Hydraulic Engineer Hydro-Electric Power Commission of Ontario



Curve on canal showing retaining walls above concrete lining where natural rock surface lies below water level



Screen house at end of forebay showing entrance to pipe-lines. The racks for screening the water and the gates for closing off the entrance of the pipe-lines are supported between the piers. There are three openings to each pipe-line.

single gate in place of two, the decision was entirely favorable to the single large gate.

Forebay Ice Chutes

It is expected that the intake as designed will take in water from the Niagara River, absolutely free from floating ice, but to take care of any ice that may form on the surface of the Canal or the Chippawa River channel, a small ice chute is provided at the lower end of the forebay. It consists simply of an opening through the screen house and down the cliff and under the power house to the lower river in a reinforced concrete pipe 10 feet in diameter.

Screens

The only feature of the screens worthy of comment is the wide bar spacing of 4½ inches in the clear and the layout of the bars and frames which are so designed that the whole frame with the bars attached is removable, thus leaving a completely unobstructed passage when they are removed. There are three bays of screens for each penstock and two frames in each bay. The tops of the screens are eight feet below the normal surface of the water and the maximum velocity of water through the screens is 2.25 feet per second. With these provisions it is not anticipated that anchor ice will cause much trouble.

Removable Gates for Penstocks

In view of the fact that a Johnson valve is being installed at the lower end of each penstock, adjacent to the turbine, it was decided to omit permanent gates in the screenhouse at the penstock entrances. To take care of any failure in the valves, removable structural gates made up in sections are provided which can be lowered into any penstock entrance by means of an electric travelling crane in the screenhouse.

Photo of canal gate, open, shown in plan on page 60

Penstocks

The quantity of water used by each turbine at full load and under normal head is approximately 1800 cu. ft. per sec., and in the design of the penstocks, the diameter was fixed by plotting up various curves showing the value of power lost due to varying velocities and their consequent friction losses as against the carrying charges on the corresponding penstocks. By this means a diameter of approximately fifteen feet was found to give the best value, but so great a diameter at the lower end required a plate thickness of over 1½ inches and this was considered beyond the limit for safe field rivetting. On this account the diameter of the upper two-thirds of the pipes was made 16 feet and the bottom third 14 feet which made the construction work feasible and at the same time gave the desired economical results. The total loss through the screens, penstocks and valves is 1.25 feet using a value of C=110 in the Hazen & Williams formula. The loss is considerably reduced by the use of butt girth joints with an outside cover plate as against the customary practice of using inside and outside courses.

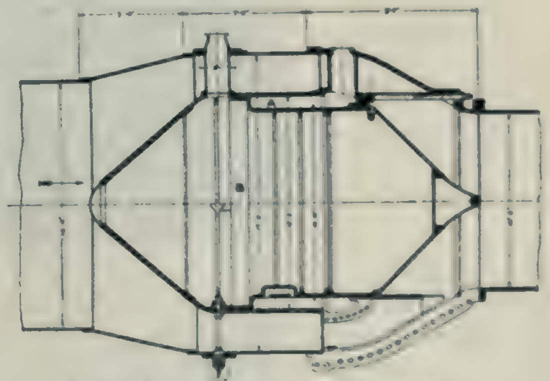
Johnson Valves

One of the figures shows a longitudinal section through the Johnson hydraulic operated valve located at the lower end of the penstock. The operation of these valves is very simple, no outside power being required, the valve being opened or closed by means of the penstock pressure. The valve plunger is of the differential type and seats against a ground fit ring in the neck of the body. The annular chamber A and the central chamber B are connected through a control valve and piping either to the penstock pressure or to the atmosphere. Admitting penstock pressure to A and atmosphere to B opens the valve while the reverse operation closes it.

The advantage of a valve of this type is its simplicity of operation. Furthermore, because of its circular section it can be built for any head and thus located at the lower end of a penstock, obviating by this arrangement the necessity of emptying and filling the penstock for each shut down.

Turbines

Four more turbines are at present under contract, which is one-half the ultimate installation. They are each of 50,000 h.p. rated capacity and of the vertical spiral case, single runner Francis type and will operate at a speed of 187½ r.p.m. This gives a specific speed of 36. The maximum guaranteed efficiency is 90 per cent, although in view of recent practice it is expected that this efficiency will be exceeded. On model runners of homologous design tested at Holyoke 91 per cent was obtained. The inlet diameter of the scroll case is 10 feet and the diameter of the runner is 10 ft. 5 in. at the inlet. An open space has been left in the power house foundations below the runner, so that by removing a section of the draft tube the runner can be taken out from below, thus obviating the necessity of dismantling the generator when a renewal of the runner is necessary. The runner is designed for a capacity of 61,000 h.p. and is "gated back" to a maximum capacity of 55,000 h.p. The



Longitudinal section through Johnson valve reason for this is that the turbines, which will normally operate at or near full rated load, will also therefore operate at their maximum efficiency.

Governor System

The centrifugal head, relay valves, and hand control for each governor will be located on the generator floor while the main automatic valve control will be located directly under the governor stand at the level of the turbine regulating cylinders. The advantages of this arrangement are the short piping between the main valve and the regulating cylinders and the separation of the two main parts of the governors, giving freer access for repairs and maintenance. The pressure fluid will be water, treated with bichromate of potassium, which will prevent rusting of the wearing parts and at the same time give a lubricating value to the water. A central pumping system will be used, with duplicate motor driven multistage centrifugal pumps, either one of which will have sufficient capacity for all the governors. The pressure fluid will be piped to all the governors through accumulator tanks, one located near each governor so as to eliminate any inertia effects through the piping system. The pump motors are automatically controlled by relay switches which are controlled by pressure variation in the system. As a further safeguard for preserving continuous operation, in the event of failure of the pumps or motors, penstock pressure can be turned into the governor system. When the plant is finally extended to its full capacity a complete duplicate pumping system, similar to the one above described, will be installed and interconnected with the present system.

One of the curves in the Chippawa canal. At this point the rock cut is 85 ft. and total cut 148 ft. in depth

Control Pedestals

A control pedestal will be set up adjacent to each generator, and on this will be mounted the various indicating instruments and control handles. The principal use for such an arrangement is that the communicating devices between the floor operator and the chief operator in the control room, together with the local control and indicator, will be located in such a way that the floor operator can handle the machine while in touch with the chief operator.

Service Units

For furnishing heat, lights, and power service to the plant two service units, each of 2500 h.p. capacity are being installed. Each of these consists of a vertical turbine running at 500 r.p.m. direct-connected to a generator. The turbines are supplied by a single 5 foot diameter penstock branching into two pipes at the turbines, each branch being provided with a Johnson valve. It is expected that the service plant will be duplicated when the power house is completed to its full capacity.

The Electrical Equipment*

The generators, of which there are two installed at present, and of which three more are in process of manufacture, are the largest and heaviest in the world. The entire weight of the revolving parts of each generator and turbine is carried on a thrust-bearing mounted in a housing above the generator proper, the bearing designed to sustain a weight of one million pounds. The heaviest part of a generator weighs 300 tons, and its removal requires the joint use of the two 150-ton cranes which have been installed in the power-house.

An exciter, direct connected to the shaft of each generator, is mounted over the thrust-bearing mentioned above.

Electric power is generated at 12,000 volts, the frequency being 25 cycles. The power from each generating unit passes through 12,000-volt oil circuit-breakers and busses to a bank of 3-15,000 kilovolt-ampere transformers, by which the voltage is increased from 12,000 to 110,000. The high-voltage power then passes through the oil circuit-breakers and busses, located in the upper rear section of the building, to the roof, where the station circuits are connected to the transmission lines, which, on leaving the station, pass up the face of the cliff over the screen-house and forebay and radiate thence in different directions.

The control room will eventually be located above the generator room over Units Nos. 4. 5. and 6. but as this portion of the building is not yet erected, it has been necessary to provide a temporary control room in the service section for present needs.

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* E. T. T. Brandon, Electrical Engineer Hydro-Electric Power Commission of Ontario

Construction Methods

From the intake at Chippawa to the power house at Queenston, as already explained, the canal measures 12¾ miles in length, of which the first 4¼ miles follow the route of the Welland River, formerly a sluggish stream with a flat gradient, whose flow has been reversed. The remaining 8½ miles of canal is dry excavation in earth and rock and is the part of the work that has involved construction operation carried out on a scale and with a speed hitherto unprecedented. From Montrose, on the Welland River, where the canal proper begins, the first mile was dredged through earth and is similar in section to the Welland River cut; from this point the canal, which runs in a general northerly and easterly direction, is all in rock with the exception of the built-up, rock-filled section, 2,500 feet long, adjacent to the Niagara Whirlpool. The lower end of the canal opens up into a triangle-shaped forebay cut into the rock at the tap of the cliff near Queenston. Where the canal is in rock, the sides and bottom are lined with concrete for the purpose of increasing its carrying capacity by virtue of the smooth surface thus obtained. It was estimated that the capacity of the canal would be increased 20 per cent. by means of the lining, but in view of the exceptionally fine quality of work as actually constructed, it is now evident that an even greater increase in flow will be obtained.

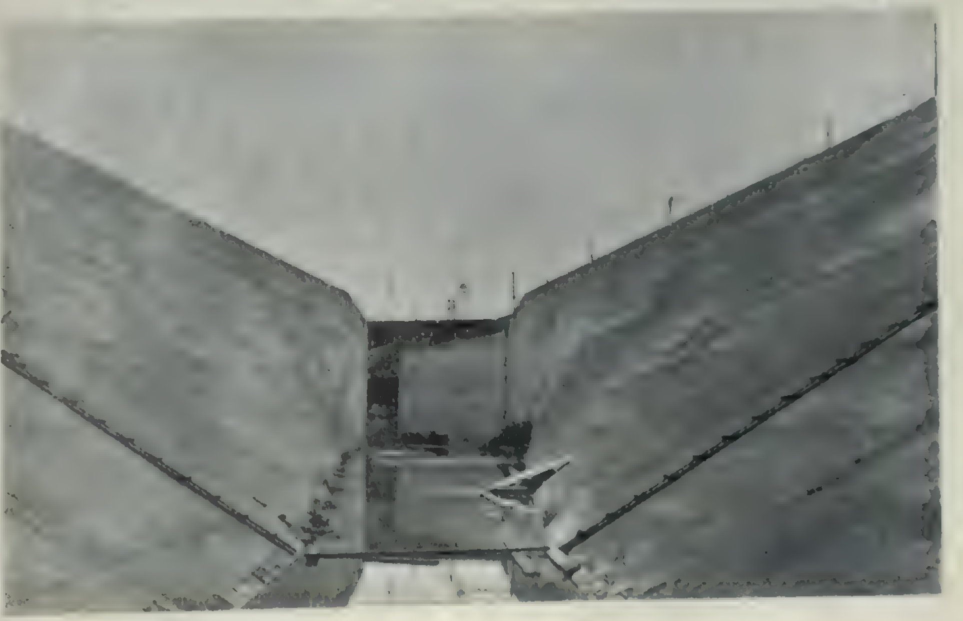
Among the special features of the canal may be mentioned the massive electrically-operated control gate located near Montrose, for controlling the flow in the canal; the deep excavation at Lundy's Lane crossing, where the bottom of the canal is 143 ft. below the level of the ground; the various railroad and highway crossings over the canal; and the "Whirlpool section." The last named is that part of the canal which crosses over an old gorge, the bottom of which was largely composed of quicksand. The construction of the canal across the valley was accomplished by first filling the whole gorge with rock excavated from other parts of the canal, and then allowing this rock-fill to come to a final settlement. After this it was excavated for the canal section and faced with a heavy reinforced concrete lining.

Unusually Large Construction Machinery

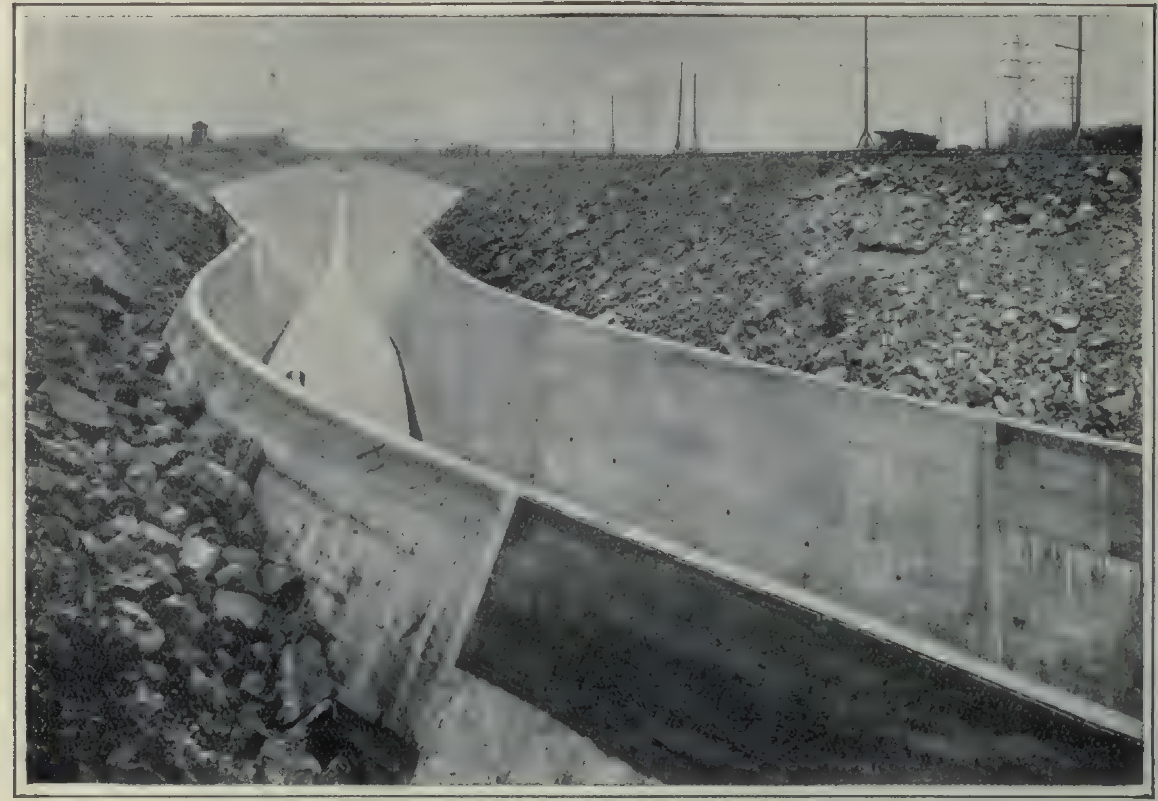
The Hydro-Electric Power Commissioner's engineers, when investigating the economics of the development, made very exhaustive investigations into the construction methods that would have to be adopted, inasmuch as the type of construction plant and the manner of its operation would have very considerable bearing on the cost of the project. From the start it was obvious that something entirely unusual in the way of plant and methods would have to be adopted to handle a construction project of such unprecedented magnitude. In the determination of the exact type of plant to be employed in the construction work certain conditions expressed themselves. These were: (1) The availability of cheap electric power for operating construction plant, (2) large quantities of earth and rock to be removed—about 17,000,000 yds.—which made it possible to consider excavating equipment of the heaviest type and largest capacity obtainable, and, (3) excellent facilities for the disposal of the spoil along the Niagara escarpment, within short hauling distance of the site of the work. With these conditions in mind, a very thorough study of various kinds of construction equipment was made by the Hydro engineers and a large amount of information was obtained concerning the output, operating costs, working conditions, etc., of all types of electric and steam operated excavating equipment.

Largest Shovels in the World

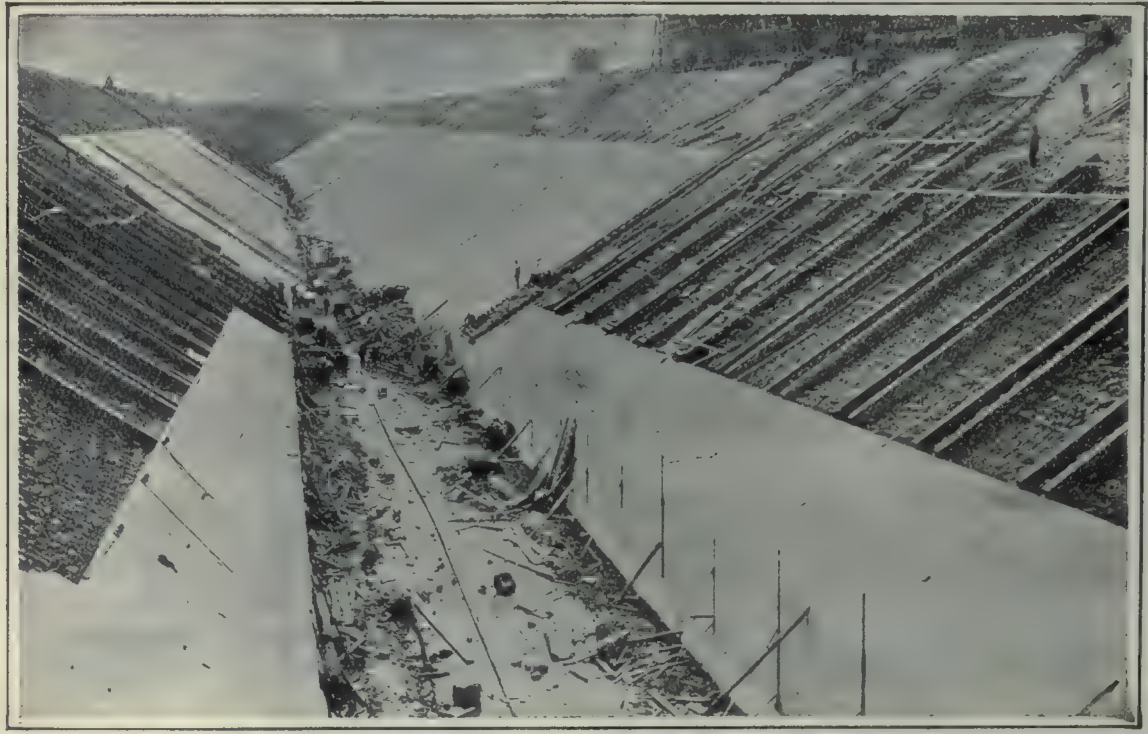
The result of these investigations was that new construction appliances, such as large shovels and special concrete forms, were created to carry on operations of the stupendous magnitude involved in this project. The excavation was carried out with the aid of fourteen shovels, most of which were electrically operated, and five of which were larger than any heretofore built. The largest shovel handled an eight cubic yard bucket for earth and one of six cubic yards capacity for rock. They weigh over 400 tons each, are operated by motors aggregating 750 horsepower for each machine and have a capacity of 150,000 cubic yards of earth or 70,000 cubic yards of rock per month per shovel. These shovels could load cars standing 73 feet above their location. They were also very speedy and were capable of loading a car of 20 cubic yards capacity, standing 60 feet above the shovel in 1½ minutes. The booms of these shovels were about 90 feet long and the dipper sticks 58 feet. Sixteen wheels, eight on each side, comprised the mounting, the machines running on two tracks (four rails) spaced 30 feet apart on centre. Two of the large shovels were



A transition portion of the canal where the rectangular section merges into the trapezoidal section. Note the excellence of the concrete lining



Power Canal showing change in shape of the canal as it passes from vertical faces of rock cut to sloping sides of Whirlpool section



Placing concrete lining in the Whirlpool section of the canal, showing various stages of construction steam operated instead of electrically driven only because the manufacturers were able to place better delivery on steam equipment. Other shovels with capacities of 7/8 to 4½ cubic yards were also used, some of these having caterpillar traction and the majority being electrically driven.

Other equipment for excavation operations included 17 channelers, numerous rock drills, dredges and a cableway excavator, the latter being used for widening and deepening the Welland River section of the canal.

Electric Construction Railway

In order to efficiently carry away the enormous amount of excavated material, a standard gauge, double track electric railway in which standard 80 pound main line rails have been used, was constructed along the entire route of the canal, with branches to the disposal areas. Eighty-two miles of track were laid altogether. The rolling stock consisted of 50 locomotives, 24 of which were electric, and over 300 air-dump cars of 20 cubic yards capacity each. The trolley wires on this railroad were offset on one side of the track to allow the dippers of the shovels to pass over the cars freely when loading them and to permit locomotive cranes to use the tracks. On temporary tracks, alongside the dump, for example, the trolley wires were carried on framed timber trestles which were mounted on wheels to facilitate removal when necessary to shift the track.

For the operation of the electric railway, electric shovels and other machinery and equipment, over 13,000 electrical horsepower were required.

In addition to the equipment above noted, other special machinery and devices were developed, which will be described in detail as this article proceeds.

Excavation Methods

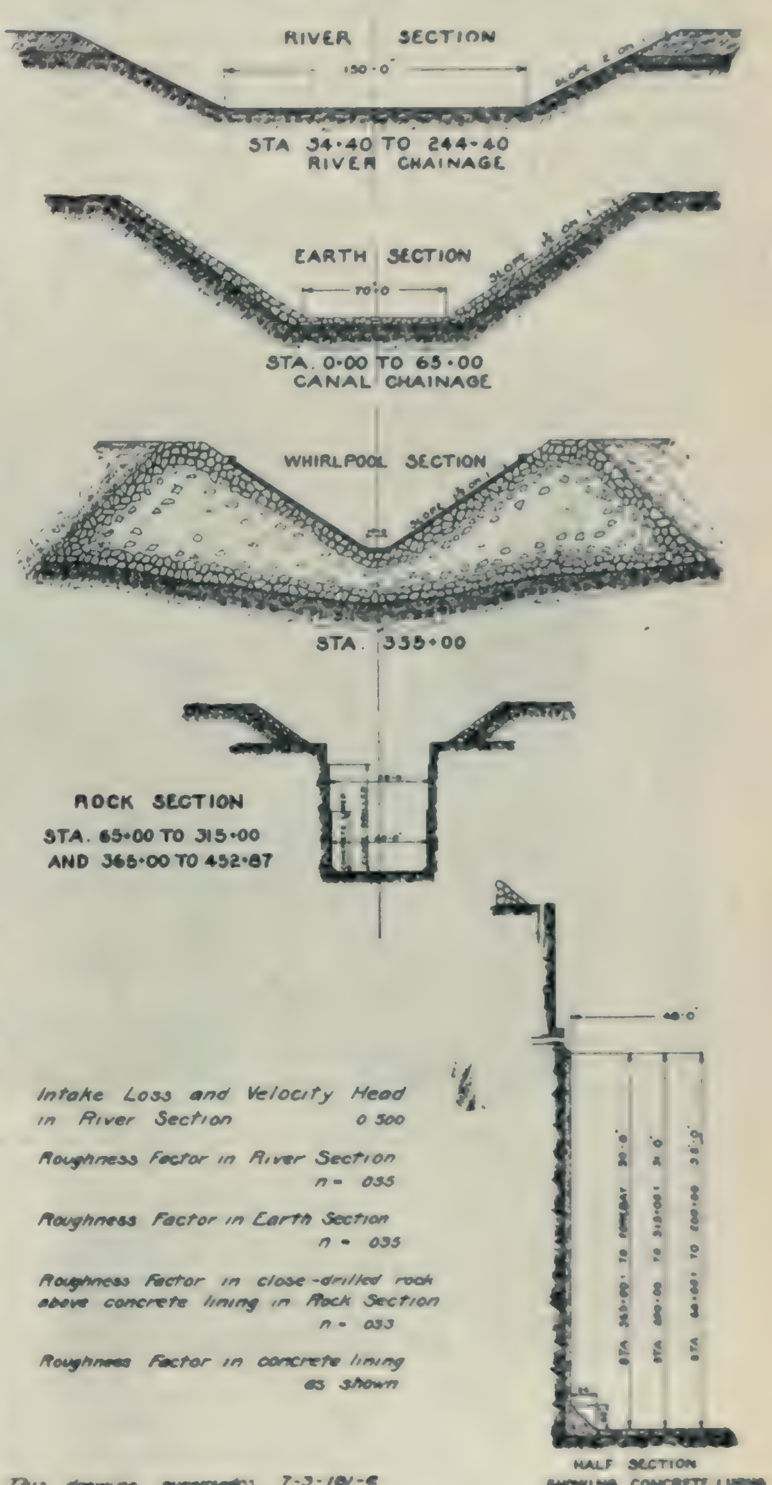
On the Welland River section of the canal, the excavation was carried out largely by a cableway excavator and by dredge. The former equipment was a Lidgerwood cableway of 800 ft. span on an 80 ft. head tower and 60 ft. tail tower, fitted with a 3 cu. yd. clam. The towers were mounted on railroad trucks running on parallel double tracks. The capacity of the plant was such that a trip of the bucket was possible every two mniutes. For the first 4,400 ft. of the river a dipper dredge was used, as bridges and other impediments interfered with the operation of a cableway. In the latter part of 1920, when it was decided to make strenuous efforts to complete the canal by the end of 1921, the suction dredge "Cyclone," the largest in the world, was transferred from the harbor development at Toronto to the Welland river, where it assisted in the excavation of both the river section and the earth section of the excavated canal. On account of the tremendous size of the dredge, considerable trouble was experienced in transferring it from Toronto to the Chippewa canal, particularly in navigating the Welland river, where bridges, power lines and shallow water offered impediments, which were successfully overcome, however, as described in the Contract Record of May 11, 1920, page 458. The work of the dredge has amply justified its use on the Chippawa work, as in 5½ months it removed 1,160,000 cubic yards of earth, an average of over 200,000 yards a month.

On the artificial section of the canal, excavation included removal of rather heavy overburden and deep rock cuts. The overburden was partly fine wet clay sand and partly very stable red clay, all of which was removed by the revolving shovels mentioned previously.

On the rock cuts, the first ten feet of the sides was channelled, but below that the rock was close drilled. The spoil was removed by the shovels referred to. The method adopted was to operate on a series of benches or cuts resembling stair steps, with one shovel following the other until the proper grade was obtained. The spoil was loaded directly by the shovels into the dump cars on the track situated anywhere from 45 to 75 feet above shovel grade

17,000,000 Cubic Yards of Excavation

The amount of material excavated from the canal proper was over 17,000,000 cubic yards of earth and rock, the earth excavation amounting to 13,200,000 cubic yards and the rock to 4,182,000 cubic yards. The deepest cuts were 72 feet in earth and 85 feet in rock. At one point—Lundy's Lane crossing—the combined earth and rock cut was as much as 145 feet deep. From these figures it is evident what a tremendous undertaking this excavation was. The speed with which it was carried out was remarkable as the entire work of constructing the canal was accomplished since March, 1918.

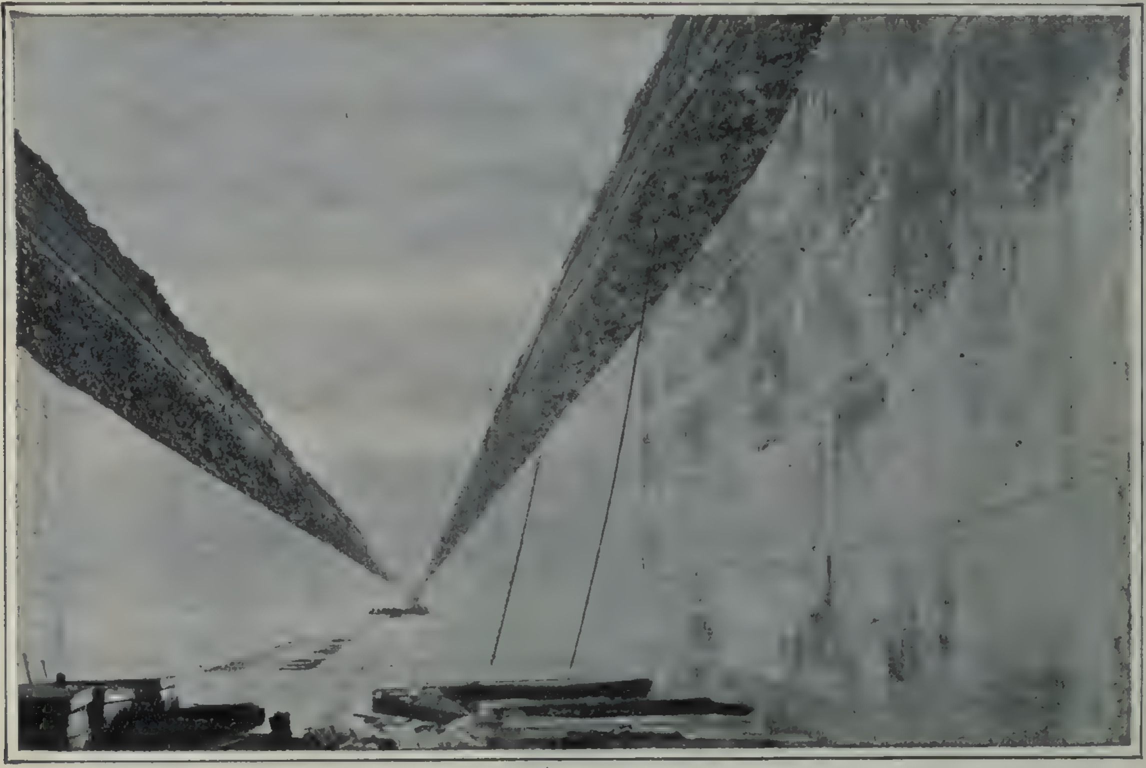


when active excavation with the large shovels began. Of course, a huge construction force was employed, at one time there being 8,100 men on the payroll, although the average force was much smaller than this.

This wonderful achievement was largely due to the type of excavating equipment adopted. The economy of the large shovels is illustrated by the fact that in 1917 when some preliminary work was commenced with railroad type shovels, direct labour cost comprised 29 per cent of the total unit cost of excavation, while in 1920, when labour was at its peak, costing 250 per cent more than in 1917, the labour cost per yard of excavation has only increased 4 per cent over the 1917 figure of 29 per cent. This would indicate that the saving of man power resulting from the use of the large excavating units practically offset the 250 percent increase in labour expenditure.

One Year's Accomplishments

The rapidity of operations possible with the plant at the disposal of the construction organization is best realized by the fact that in the past year 3,710,000 cubic yards of earth and 2,410,000 cubic yards of rock were removed. Twelve months ago only 7,000 feet of the rock cut was completed to a maximum depth of 60 feet. Since that time, the whole canal has been completed, quite aside from work on the screen house and power house—surely a stupendous and wonderful achievement.



Looking up a portion of the canal, with concrete lining completed. Note group of men in distance.

In excavating the canal, the general method was to start a pilot near one side of the canal prism with a railroad shovel loading cars on the ground surface. In this cut were run the loading tracks for the big shovels which followed a pilot cut on the rock surface. The loading tracks connected with the main line at both ends. The shovels worked through in steps, as already explained, loading the spoil into dump cars, which were operated in 8 and 10 car trains. As many as 300 trains a day were often necessary to dispose of the excavation.

The rock was drilled, except for the first 10 feet, which was channelled. Rock drills of standard type were employed as well as submarine drills mounted on high frames similar in design to a pile driven rig. Each drill on equipment of this sort was carried in the 55 foot leads of the frame from the main line of a hoist mounted on a platform behind the leads, a spare line on the drum being used to elevate the drill steels when required. The frames were loaded on skids or rollers to facilitate shifting within the canal prism. The drills were of a maximum diameter of 4½ inches and minimum diameter of 2 inches.

The forebay excavation was begun by shooting out a 10 foot lift over the entire area, about 1,100 holes being fired at once. About one pound of dynamite to the yard, including that used for springing the holes, was used. Each hole was sprung with 5 or 6 sticks and loaded with 15 or 20 sticks, the spacing being 7 feet each way. As a result of this initial blast about 60,000 cubic yards was broken up fine enough to be handled by the railroad shovels.

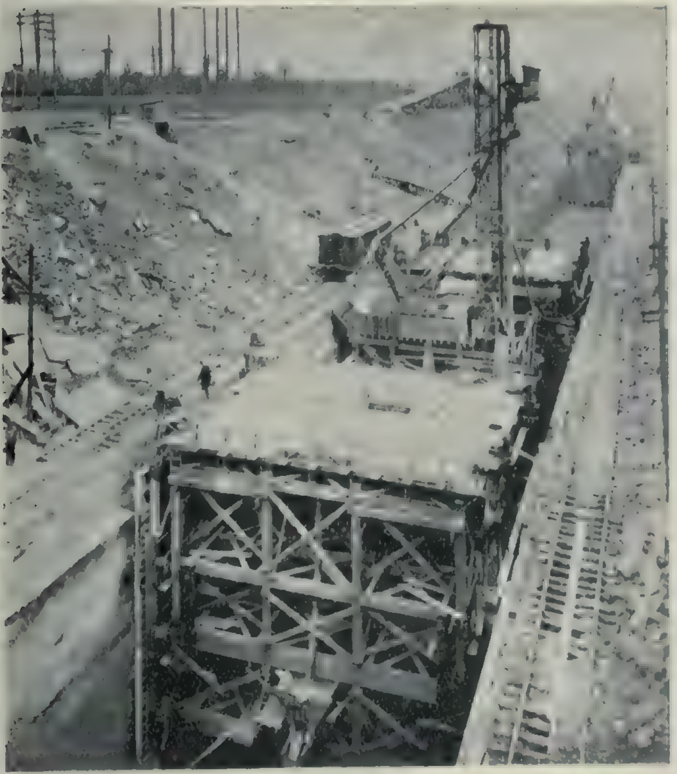
Bridges Built Before Excavation

About 17 bridges were required to carry highways and railways across the line of the canal. On some of these early construction was essential to the prosecution of the excavation and for that reason were constructed before any of the digging was carried out in their vicinity. This gave rise to the remarkable phenomenon of bridge structures erected below the ground surface, the shovels later removing the earth from around and beneath them. When bridges were built in this way, an enclosure of steel sheet piling was used as a cofferdam. This manner of constructing bridges made concreting operations very easy inasmuch as a mixer was placed on the edge of the excavation to spout the concrete directly into the forms.

Disposal of Spoil

Practically all of the excavation had to be wasted Some of the rock was used for concrete purposes and some for riprap, and at the whirlpool gulley about 1,500,000 yards of rock obtained nearby was dumped and allowed to consolidate but practically all the rest was conveyed to a 200 acre dump capable of holding 21,000,000 cubic yards. Some smaller dumps were used, but the one mentioned which was two miles from the canal received the greater part of the spoil.

This fill was reached by a double track spur of the construction railway. The trolley wires along this dump were carried, as explained before, on portable frames. These frames with outriggers for the trolley supports were mounted on flanged wheels which run on short sections of track set up on the filled side of the tracks on which the dump trains ran. As the fill progressed and the filling tracks needed to be shifted, the trolley towers were moved accordingly. When first dumping the fill, a trestle was built well out into the middle of the dump area and the fill started from it. In addition, the tracks fanned out over the side from the corner where they entered the dump. In this way sufficient places of dumping were maintained to take care of the spoil without any train interference.


The plant for lining the side walls of the canal. Two form carriers and a mixer unit comprise the equipment.

Crusher Plant

The crusher plant was located near the forebay and received material by rail in the 20 yard dump cars, which discharged direct into a large hopper lined with 2½ x 6 inch steel bars laid flat. The crusher fed from this hopper was a 60 x 84 inch jaw outfit operated by a 250 h.p. motor, reducing the stone to 8 inch size and delivering it to a belt which took it to the top of the secondary crusher house. In this were three gyratory crushers reducing the stone to 2 inch size. From these crushers the material passed through a screen which removed dust and oversize stone and then was carried on a suspended belt conveyor over the storage pile. At the end of the storage pile was the bin structure for the receipt of 1 inch stone used for reinforced concrete. The 1 inch stone was obtained by passing the oversize into small auxiliary gyratory crusher which delivered its product directly to the bin mentioned above.

The sand was brought in by car and dumped into a track hopper from which it was carried on a 14 inch conveyor to a bucket loader which lifted the sand to an overhead conveyor running over the storage pile which was adjacent to the stone pile. Reclaiming conveyors beneath the piles carried the aggregates to the concrete mixing plant at the top of the escarpment, from which plant the screen house and part of the power house were concreted.

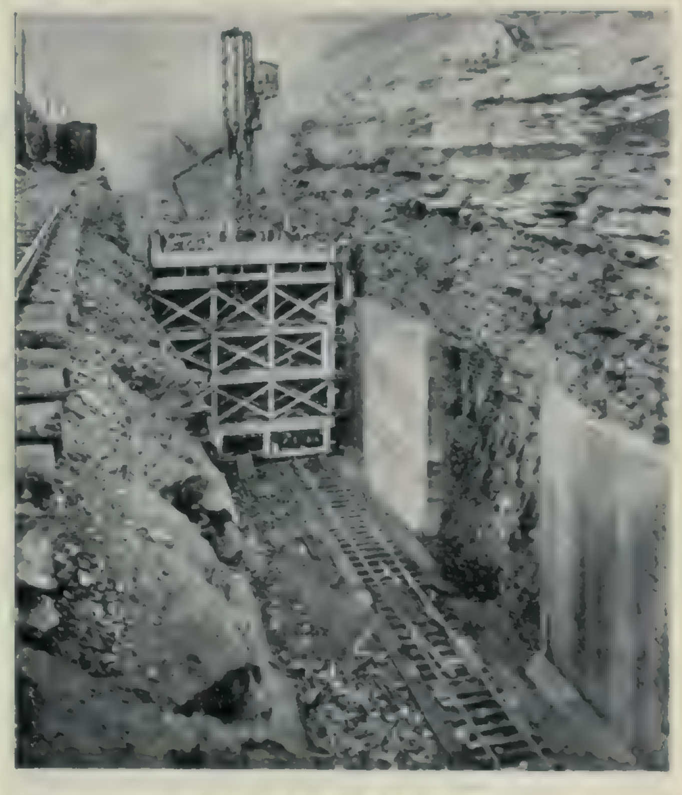
Scaling of Rock

All of the rock, except in the forebay, was scaled before the concrete lining was applied, in order to remove uneven projections. This work was done with movable towers which practically occupied the entire canal prism. These scaling towers were simple wooden frames mounted on trucks for movement on sectionalized track. At each side was a platform suspended by wire cables from sheaves on top of the frame and counterweighted for easy movement. From these platforms the scalers removed all pieces of rock projecting over the line of the clean cut which was indicated by a plumb line hung from the top of the trestle. The scaling was done with picks and hand air tools, the air being supplied from the pipe lines parallelling the canal.

At the same time as the scaling was carried out, dowels of old steel rods were grouted into the sides of the cut at 4 ft. intervals in both directions, in order to bind the concrete lining to the rockface. These rods were about ¾ inch in diameter, 2 ft. 9 in. long, embedded 2 ft. in the rock and bent up vertically so as to hold the concrete lining.

Lining of the Canal

After the rock sections of the canal were excavated and sealed, they were lined with concrete to reduce water friction. This lining was from 30 to 32 ft. high. The floor was at first paved with at least 6 in. of concrete laid in three longitudinal slabs—two slabs each 13 ft. wide, spaced 18 ft. apart, this 18 ft. space being later filled in. The typical plant for carrying out this work consisted of a 1-yd. paving mixer with chute, mounted on a flat car, which also carried an overhead bin to hold sand and stone, and a cement platform. A chute, fastened to the frame and extending to the construction


Placing concrete lining on rock sides of canal. Completed sections, 40 feet in length, in foreground

railway on top of the cut, permitted sand, stone and cement to be passed to the mixing unit.

When the floor was laid, the sides were poured, special equipment being used to do the work. Nine of these plants were in use, each one consisting of one concreting unit and two form carrying units, the three comprising a "battery." Each section of the battery was mounted on trucks running on two parallel tracks (4 rails) and while each was capable of independent movement, the three were operated in conjunction as a self contained outfit, forming and lining the two sides of the canal at the same time.

The centre of the three sections of the battery formed the mixer unit and comprised hoppers for the storage of sand and stone, a large capacity steam mixer and a hoist tower with spouts for chuting the concrete to place in the forms. The other two sections were form carrying units, each consisting of a timber frame filling the canal prism and carrying the wall forms which were steel plates on a steel framework. Jacks were inserted between the frame and the forms, so that the form could be adjusted in proper alignment and so that it could be swung back after the concrete had set sufficiently to allow the unit to be shifted to the next position.

The walls were poured at least 6 in. thick in alternate 40 ft. sections, one form unit being used for the first pourings and the other for the intermediate pourings. The forward form unit was provided with side bulkheads to retain the concrete but the second unit, of course, did not require these and the wall slabs already poured acted as retainers. A fillet was formed at the junction of the wall and the floor, this being poured with the wall. For easy chuting and for spading, etc., the wall forms were built in removable sections. As soon as the concrete had set, finishers patched up any uneveness.

Reinforced Lining on Whirlpool Section

On the Whirlpool section, a different procedure was adapted. This portion of the canal was trapezoidal with side slopes of 1 on 1½ and the lining was laid on the slope and heavily reinforced. Three-foot strips of concrete were first laid by ordinary methods up the slope at 18 ft. centers. The intervening spaces were then filled in. At the beginning wooden forms were used, these being in panels 3 ft. wide by 16 ft. long, attached to the concrete strips by anchor bolts. To get away from the carpenter work entailed by these forms, a steel screed or sliding form was later devised. This measured 16 ft. long by 17 ft. wide, and consisted of one thickness of ¼-in. steel plate with a 9 in. channel around the outside and reinforced with 9 in. channels placed horizontally across the plate at 9 in. centers. The drawbar was a continuation of side channels, brought together about 6 feet ahead of the form. A hand winch was placed at the top of the slope by which the form was moved upward.

The botom 20 ft. of each panel was poured behind the regular forms and allowed to set. The steel form was then placed on this and kept moving slowly up the slope, the concrete placed being kept almost even with the top. By the time the plate had passed over the concrete it was set sufficiently to stay in place. The result of the use of the steel form was a much more uniform face and a better chance to finish, as finishers could get to work sooner and could work on green concrete. Only one finisher was allotted to each panel, he following the form as it went up the slope

Some of the finest concrete on the canal is at the transition sections, where the canal changes from earth to rock and from rock to Whirlpool sections. At these points, the lining was applied in smooth curves to reduce friction to a minimum and special care was taken in pouring to avoid any irregularities.

In the forebay a smooth lining was not deemed essential, as the velocity of the water is very low. However, the rock wall was sealed by a coating of gunite to a depth of a few inches.

Power House Construction

The power house, located at the foot of the cliff, near Queenston, involved very interesting construction methods. Inasmuch as the whole of the building is not required at present, the superstructure as constructed today is only one-fourth of the ultimate length. The substructure, however, is completed for the entire building.

The excavation for the power house substructure was entirely in rock on a comparatively flat site immediately adjoining the river. In order to obtain sufficient area under the turbines to permit the spent water to discharge into the river, it was necessary to excavate the rock for a depth of 25 feet below the surface of the river. To enable this work to be done in the dry, the rock shore adjacent to the river was left undisturbed so that it formed a dam between the river and the work. It proved to be very watertight, only one small pump, operating intermittently being required to maintain the site free from the usual water difficulties. This favourable circumstance enabled a high quality of foundation work to be done in this vital part of the plant and at the same time afforded an exceptional opportunity to make a thorough examination of the underlying rock strata, which proved to be dense and sound. At no point was any sign of settlement apparent.

The excavation was straight rock work, the spoil being removed by dump car over a siding which was built along the river edge. This railway also served to bring in material from the sorting yard located near Queenston.

For concreting, a large mixing plant was stationed on the face of the escarpment a short distance from the top. From this plant the concrete was chuted through suspended troughs to the work. Relay towers were erected at various points from which the concrete was re-directed as necessary.

The steel erection was carried out by means of a two-derrick wooden traveller on wheels.

Obituary

Mr. George Tillson, of Tillsonburg, Ont., died recently in his 61st year. Deceased was the son of the founder of the town, the late Mr. E. D. Tillson, and took an active part in the town's development, having been for several years a member of the town council and the local hydro commission. He was also president of the Tillsonburg Water Works Company.

Two of Western Canada's most prominent contractors, W. H. Carter and Wm. Hurt, snapped while watching the reception accorded Premier Meighen at Portage la Prairie. Study attitude and expression and guess their politics.

Chippawa-Queenston Power Canal

General Data

Installed capacity for 9 units	500,000 horse-power
Effective head	305 feet
Capacity of each unit	55,000 horse-power
Length of river section	4 miles
Length of canal	9 miles
Deepest cuts	72 ft. in earth and 85 ft. in rock
Greatest cut, combined earth and rock	145 feet
Width of finished water channel in concrete lined section	48 feet
Depth of water under normal operation	35 feet

The maximum velocity in the canal will be 10 ft. per second.

The forebay, 1,000 ft. long, widens from the standard canal section to 500 ft. at the gate house

Diameter of steel penstocks	16 feet

The power house, when completed, will be nearly 700 feet long, and 185 feet high from the base.

Total earth excavation	13 million cu. yds
Total rock excavation	4 million cu. yds.
Total concrete	500,000 cu. yds.
Highway and railway bridges required	13
Work was commenced	May 1917
Canal was put into service	December 1921

PLANT USED DURING CONSTRUCTION

Suction dredge	1
Cableway excavator	1
Dipper dredge	1
Shovels	14

The 5 largest shovels have each a daily capacity (20 hrs.) of 6000 cu. yds. in earth, and 3000 cu. yds. in rock, with an eight yard bucket. These shovels have a lift of 80 feet from shovel grade into dump cars.

CONSTRUCTION RAILWAY

Mileage of track	80 miles
Electric locomotives	24
Steam locomotives	26
Air dump cars	320

CONCRETE PLANTS

Crusher plant	daily capacity 3,000 cu. yds.
Sand storage capacity	100,000 cu. yds.
Stone storage capacity	250,000 cu. yds.
Stationary concreting plants	9
Movable paving plants	4
Movable lining plants	9

COMPRESSOR PLANTS

28 units electrically driven, providing 30,000 cu. ft. of free air per minute.

BUILDINGS

In all there are 500 temporary buildings.

There are five camp districts for employees, providing accommodation for 6000 men.

With few exceptions, machinery on the work is driven by electric power. The normal power load for construction purposes is 13,000 horse-power.

Suppliers of Equipment

Generators Nos. 1, 2 and 5 and two service generators—Canadian Westinghouse Co.

Generators Nos. 3 and 4—Canadian General Electric Co.

Turbines Nos. 1 and 2—Wellman, Seaver, Morgan Co.

Turbines Nos. 3, 4 and 5—William Cramp and Sons.

Turbines—service—Canadian Allis Chalmers Co.

Main Governors—William Cramp and Sons.

Service governors—Canadian Allis Chalmers Co.

Supply pipes—Wm. Cramp and Sons.

Johnson valves—Larner Johnson Valve & Engineering Company.

Penstocks—Dominion Bridge Co.

Penstock welding—Lincoln Electric Company

Screen house gates and racks—Standard Steel Construction Company.

Power house and screen house cranes—Dominion Bridge Company.

Control gate and ice chute gate—Dominion Bridge Co.

Structural steel—Canadian Bridge Co., McGregor and McIntyre.

Shovels—Bucyrus Co., Marion Steam Shovel Company.

Steam Locomotives—Montreal Locomotive Works, Baldwin Locomotive Works.

Dump Cars—Canadian Equipment Co., F. H. Hopkins and Company.

Channellers—Sullivan Machinery Co.

Drills—Sullivan Machinery Co., and Canadian Ingersoll-Rand Co.

Drill steel—Samuel Osborne, H. L. Usborne, Crubicle Steel Co. of America.

Crushers—Traylor Engineering Co., Power and Mining Machinery Company.

Conveyors—Mussens, Ltd., Robbins Conveyor Belt Co.

Concrete Mixers—Ransome Concrete Machinery Co., London Concrete Machinery Co.

Towers, chutes and spouts—Mussens, Ltd.

Cableway—Lidgerwood Mfg. Co.

Sheet Piling—Lackawanna Steel Co.

Cement gun—General Supply Co.

Reinforcing steel, rails—Steel Co. of Canada, Algoma Steel Co.

Locomotive cranes—F. H. Hopkins.

Explosives—Canadian Explosives, Ltd.

Pumps—Turbine Equipment Co., General Supply Co.

Hoists and derricks—F. H. Hopkins, Mussens Ltd., Canadian Mead-Morrison Co.

Boilers—John Inglis Co., Waterous Engine Works Co., Engineering and Machine Works of Canada, Ltd.

Conveyor—Barber-Greene Co.

Pile Hammer—McKiernan-Terry Drill Co.

Cement—Hanover Cement Co., Alfred Rogers, Ltd.

Sand—National Sand and Material Co.

Bridges—Hamilton Bridge Co., Canadian Bridge Co.

Manganese steel—Taylor-Warden.

Brake shoes and car wheels—Dominion Wheel and Foundries, Ltd.

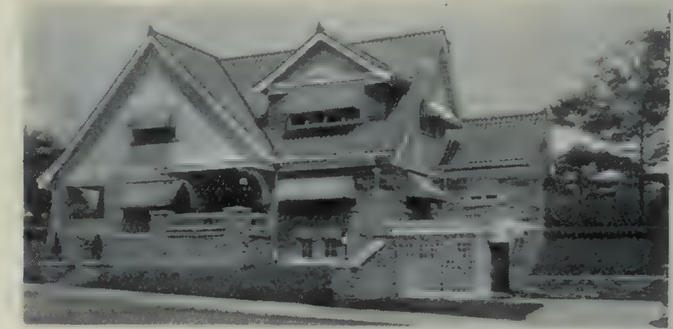
Electric locomotive parts—Canadian Car and Foundry Co., Canadian General Electric Co., Canadian Westinghouse Co.

The Contract Record's Weekly House Suggestion

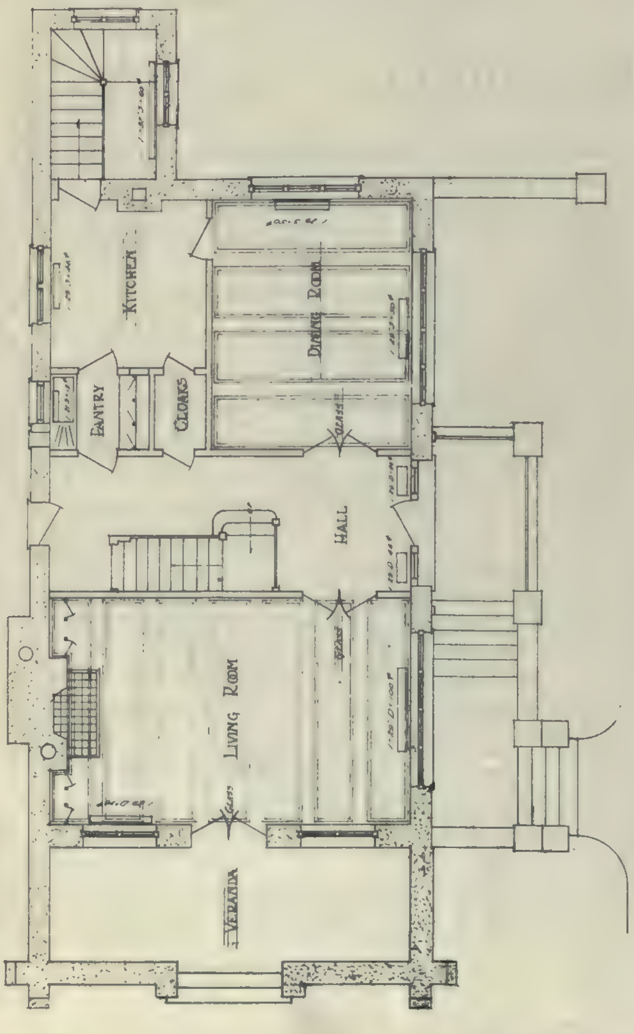
The attractive stone residence illustrated herewith was completed recently at the corner of Bloor St. and Oakmount, Road, Toronto, for Mr. J. W. Commeford. The stone used is Credit Valley piebald gray, with New Brunswick red stone used for trim. The stucco work on the first floor is laid on hard burnt brick. The roofing is of Ludowici red Spanish tile, and is a decided factor in the pleasing exterior appearance of the residence. Both front and side verandahs are laid with red floor tile.

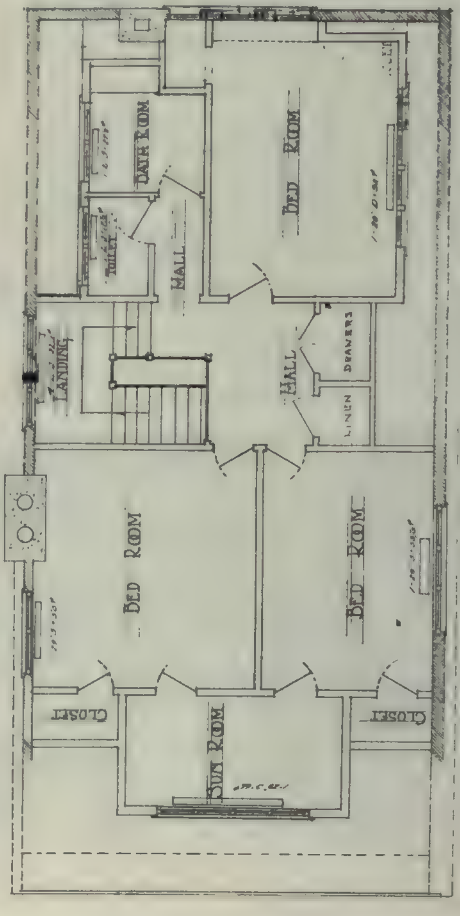
The ground floor is divided into two sections by a through hall, a large living room occupying the entire section to the left, while the section to the right is subdivided into dining-room, kitchen, pantry and cloakroom. . The ground floor is oak, the dining-room being pannelled to a height of 6 ft. and the hall to a height of 4 ft. 6 in. Plain white oak flooring is used throughout the ground and first floor. There are oak beam ceilings in the living room and dining room, and a large tapestry brick fireplace in the former, as shown on plan, with built-in bookcase. occupying the intervening space to the walls on either side. The owner, Mr. Commeford, who is an electrical engineer, personally supervised the wiring of the house and provision was made for every possible electrical convenience.

The first floor plan provides for three large bedrooms, sun room, bathroom and separate toilet, all conveniently laid out with easy access from the main hall. The interior finish is poplar, enamelled white, with the exception of the sun room which is finished in French gray. The bathroom and toilet are finished in 3 in. x 6 in. white wall tile and 1. in. hexagon floor tile, the former being equipped with built in bath and shower. Ample provision has been made for closet space in all bedrooms, and a roomy linen closet and set of drawers are located in the hall.



The house was designed by Mr. J. A. Thatcher, architect, of 24 King St. W., Toronto, and erected by Messrs Hawken & Kelly, of Toronto. The stucco work and plastering was done by Messrs. Boyce & Son, while the roofing tile was supplied by the Roofers Supply Company, Canadian agents for the Ludowici Tile Co., of Chicago, the manufacturers.





Engineer Needs to be a Business Man

R. C. Harris, Commissioner of Works of Toronto, Outlines the Qualities that Should be Developed in Every Engineer in Order that He May Obtain Complete Success

The student members of the Engineering Society of the University of Toronto listened to a very interesting and instructive lecture, by Mr. R. C. Harris, Commissioner of Works of Toronto, on the subject of "Engineering Education", at the Mining Building last Wednesday afternoon. Professor Gillespie introduced the speaker and in a few words expressed the appreciation of the society at being given the opportunity of listening to an address on this important subject.

"The engineer," said Mr. Harris in commencing "comes from the University essentially a builder and feels it his duty to design, draft and build, but he rarely has a proper conception of engineering in relation to business. Although there are many exceptions, I am going to try and convey the impression I have gathered from engineers I have met, not only in Toronto, but throughout Canada and the United States. The engineer does not think sufficiently in terms of the dollar. He is a trustee of the health and comfort of the community, and, to some extent the public's banker. To him are entrusted the problems of securing pure water, proper sewerage, clean air, etc., yet it is said, and in some instances not without proof, the engineer is not a good administrator. That fault lies not so much with the individual as with the system. In my opinion, the engineer should be trained as an administrator. He has ability for administrating; he has analytical ablity and has been taught to think properly." The speaker went on to point out the importance of making a study of one's self and of others. "Business", he said, "is looking for the man who studies and understands others. That is one of the greatest traits evidenced by men of technical education."

Not Enough Business Training

Continuing, Mr. Harris said, "The engineer deals too much with concrete things, with the result, I fear, that he very often loses sight of the business consideration relating to the particular work he has in hand. He designs and visions the finished product, but how often does he relate the design to the economic factor? How often does he think in terms of dollars? I have found, in my somewhat wide experience, that this is a common deficiency. A great engineer once said to me that his greatest difficulty was to secure men who could relate the value of the finished work to the value of the dollar. The student should become equipped with vision. I mean the proper vision by which he can relate men and money and things."

He referred to the keen visionary powers of the engineers responsible for the development of the huge new Chippawa canal, a project that had been largely criticized by many who could not see a possible market for the enormous quantity of power developed. "Sir Adam Beck had sufficient vision to purchase land to build another canal, of a similar capacity to the Chippewa. That is vision, for we find that notwithstanding the uneasiness felt in some quarters as to the disposing of the developed power from the Chippawa project, this market is now assured.

Habit of Reflection

"One difficulty we find," continued Mr. Harris, "is that we have insufficient time for reflection. In these years when students are going through the University, they should acquire the habit of spending a certain amount of time each day on this practice of reflection on their work, their future, etc.

"The engineer requires essentially to be a man of courage, a man with vision to look into the future and design his work with the assurance that he is right and that the future will demonstrate the reasonableness, the safety, the usefulness of his work. I have had some experience with men who risked large sums of money on convictions which they possessed. We should not be too conservative. Be ready to branch out; do not hesitate because the thing has not been done before.

"The engineer, again, should have the courage to protect his client, to give him that which is required rather than that which is desired. In looking over the engineering works which have proven failures, we find that in many cases this was not because of the lack of knowledge, but because of the engineer's lack of strength to enforce his convictions. I would counsel, therefore, that the engineer protect his client against himself, where necessary, and at the same time protect his reputaton as an engineer. Unfortunately, engineers, as a rule, are content to permit the client to dictate the remedy, losing sight of the fact that he is unfair to himself and to his trust. If a physician is called in and the patient asks for morphia, when he needs a dose of calomel, the physician does not give him the morphia because he asks for it. The physician is the doctor of the individual, but the engineer is the doctor of the community. In the end, it is the engineer who must bear the censure, if any mistakes are made.

"Many men are failures as engineers, because they lack initiative; they do not do the proper thing at the proper time, but are content to travel along the beaten path, content to follow the lead of others...... Do not be afraid to reach out. You will make mistakes, every man does, but a mistake is of infinite value when we learn a lesson. Your client is entitled to the best and if he is going to get the best, you must be a positive, not a neutral."

The speaker went on to impress the importance of engineers enforcing their views and of protecting themselves by a written statement forecasting the results of unsafe undertakings, which practice would have saved the reputations of many engineers, which had been sullied by apparent failures.

"Use your head", counselled the speaker, "use it for the benefit of your clients, use it to the benefit of your profession, to the benefit of your society and to the benefit of the public in general........"

Remuneration of Engineers

The speaker touched on the matter of insufficient remuneration for engineers, saying in this connection

"It is a matter of remark that fees of engineers are quite unworthy and that, to my mind, is largely the result of the engineers not having a sufficient appreciation of themselves. Have a proper appreciation ot yourselves and see that you get, in return for your services, just remuneration." He went on to criticise the practice of cutting the expenditure on an undertaking to the lowest possible figure. "The business man of to-day wants results," he said, "and these cannot be obtained without an adequate expenditure of funds. You will be judged by your failures---your successes will be taken as a matter of course. We have instances where the estimate is below what the work can be done for. This has caused a feeling of distrust among those who call in engineers. They wonder if they will have to pay double or treble the estimated cost."

Another failing the speaker had noticed among engineers was the dislike in many cases, on the part of engineers, to delegate their authority, saying in this regard, "The business world is looking for men to accept responsibility, and until the engineer realizes he must do this, he falls short of the essentials which spell success."

Equipped to Handle Emergencies

The next point dealt with by the speaker was that part of an engineer's training which should equip him with the capacity to handle emergencies, for the life of an engineer, he said, is practically one long emergency. He quoted instances where men in the engineering industry, by reason of their clarity of vision, their ready decision and courage had known the right thing to do at the right time, which had resulted in the saving of time, property damage and even loss of life in instances.

"The engineer is somewhat insular," he said, "and has a tendency to live to himself and to associate only with men interested in the things he is interested in, and this is easily understood, but it is a great mistake. The engineer should come out and meet business men in various branches of industry, so that he may get some of their perspective and absorb some of their vision and viewpoints. This practice will redound to his benefit. The engineer moves on when he is done. He does not understand the world and the world does not understand him. The people in general have no conception of the work he is doing. You should disseminate knowledge of your work. People take things as a matter of fact, they think that the securing of a water supply is a matter of sticking a pipe in the water putting something on the end of it and getting the water to them.

"I do not know," he said in closing, "what provision is made by the University for the faculty to go abroad and study the methods and systems of other countries, but if such provisions are not made, the universities of this country are not doing their duty to themselves or to the citizens. They should go to other countries and visit other institutions and reflect this knowledge to the students going forth from the universities."

Pier Failure Endangers Concrete Bridge

A Lesson for Designers in the Settlement of the Foundations of an Arch Bridge in Arizona—Interdependence of Sub- and Superstructures Forcibly Demonstrated

The interdependence of superstructure and foundation was forcibly brought home to all designers by the failure of one pier of a concrete arch bridge across the Salt River at Tempe, Arizona. The bridge was built in 1911-1913 and is a link in the main highway route from Phoenix and the Salt River Valley to the eastern and southern portions of the state. It is crossed by about two thousand five hundred vehicles per day. There are eleven two rib, three-hinged arches with open spandrels and the spans are one hundred and twenty-five feet. Nearly all the piers were carried to rock in open excavation but some rested on concrete cylinders sunk to rock. It was one of these steel cylinders that settled.

The first settlement that was noticed was four and one-half inches at pier number nine, the second from the north end of the bridge. There was no interruption of traffic for several weeks when a further settlement of one-half inch occurred. A two-ton limit was placed on the bridge but three weeks later the settlement reached six inches and the bridge was closed to traffic. The following day there was a sudden drop of nearly five inches bringing the total settlement to nearly one foot. The pier also shifted down stream about 0.1 ft. Although the roadway had settled almost a foot, there were no cracks visible in the concrete in the region of settlement with the exception of handrails which were badly cracked. The longitudinal steel no doubt prevented the fine hair cracks from showing. Falsework was erected to provide a temporary support for pier number nine by means of heavy timbers and the bridge was thrown open to traffic in little over a month from the time the last settlement was noticed.

By sinking the foundation for pier nine to rock by using steel cylinders, the sand and gravel around the pier was left in its undisturbed condition and doubtless some of the load was carried by this gravel by way of the pier block which rested on the two cylinders. It was found on examination of the conditions at the base of the pier that all the sand had been scoured out with the exception of some thin layers over the bed rock, leaving the pier supported on the two cylinders, which proved inadequate to carry the load. In the light of difficulties subesquently experienced in sinking new cylinders it is very probable that the concrete in the base of the piers was of very poor quality or that a foot or so of gravel had filtered into the cylinder after the rock had been cleaned off. This would cause the crumpling of the steel at the bottom which is what actually happened, it is believed.

A number of other defects were found and it was thought advisable to do all the repair work at the same time. Several of the spandrel columns were broken in horizontal shear near the extrados and several spandrel walls near the crown had pulled loose from the arch rings. The roadway slabs and the spandrel arches were cracked completely through in a number of places and there was considerable trouble at the floor expansion joint.

Prevention of Further Settlement

As already mentioned emergency measures were taken, immediately after the last settlement had taken place, to stop any further movement of the pier. Sand bags were thrown around pier nine to prevent further scouring and towers were built at the crown of spans 7-8 and 10-11 with the object of saving the remainder of the bridge in the event of the spans on either side of pier nine going out. On account of the depth of the water it was found to be impossible to build supports any closer to the damaged pier. No settlement of the pier occurred after these supports were erected and later in the month piles were driven in the bed of the stream on which to place timber bents in spans 8-9 and 9-10. In this manner all the load was taken off pier nine and the work of underpinning was proceeded with.

The general scheme of repair was to sink six new cylinders, three on either side of the two existing ones, cut out parts of the pier block and insert reinforced concrete beams to transfer the load to the new cylinders. A great deal of difficulty was experienced in keeping the sand silt off the rock while the anchor holes were cut and it was found that grouting had to be resorted to in order that the cylinders could be pumped clean. The anchor bolts were then placed, the cylinders concreted up to the bottom of the pier block, and the reinforced beams placed from one cylinder to the other.

No effort was made to raise the pier or floor but the handrail was rebuilt to remove the appearance of sag and it is proposed to fill up the depression in the roadway with some kind of paving block.

While the failure is not considered serious, in that no lives were lost, yet the amount of time and money spent on the repair of this bridge certainly justifies the conviction that more care should be taken with the design and construction of projects of this kind. Although the bridge stood up for a number of years without any sign of weakness, it was only necessary to have scour take place around the piers to have one of them fail and the fact that a great deal of damage was not done can be attributed largely to the continuity of the minor structural elements and the possible lateral resistance of the soil around the piers.

Underwriters' Laboratories

The division of the Protection Department of the Underwriters' Laboratories engaged in the investigation of fire retardants hsa been extremely busy throughout the year, in spite of the fact that comparatively few council reports have been published. This is accounted for by the fact that an unusually large number of the devices tested have not given results under test that have warranted listing them as standand devices of their class, and because the laboratories have been authorised to pass upon many devices without submitting formal reports to council.

The hollow metal and metal-clad doors tested during the past year, generally speaking, have been of the usual design and incorporated in their construction no unusual features. In window construction the tendency among the manufacturers of hollow metal windows appears to be towards the construction of a heavier window, with a view to increasing the durability. These windows are generally spoken of as steel plate windows to distinguish them from the sheet metal windows on the one hand and the solid section windows on the other. It is possible that the Laboratories will conclude to adopt this designation. During the year the Laboratories have tested one hollow metal door designed for use in passenger elevators. Report on this door has not as yet been forwarded to the Council and it is considered worthy of comment only because horizontally sliding passenger elevator doors have never before been submitted for test and the study of the device brings up some unusual features.

Tendency in Roof Coverings

Judging from the character of roof coverings submitted, the tendency appears to be towards the use of asphalt saturated rag felt shingles in place of the of the old roll roofing. This indicates a decided advance in the fire protection afforded as well as in the durability of the covering used, as shingles have at least twice as great a thickness when laid as the old roll roofing and are uniformly coated with an inert surfacing such as gravel, slate or materials of like character. In addition two manufacturers are developing an asbestos felt shingle, which, under test, gives much better results than the rag felt shingle.

The investigation of building materials has proceeded very slowly, owing to the necessity of coming to an agreement with the manufacturers regarding the limitations in the scope of the reports. A great many buildings materials such as tile or brick can be used for building structures which have all degrees of fire resistance. In accordance with the way the devices are assembled the results of test do not in a great many instances furnish sufficient definite information to allow the Laboratories to give an opinion regarding many types of construction in which the building units are used. It is expected that before long the Laboratories will issue reports on some of the usual forms of wall constructions, classifying these constructions in accordance with the new fire resistance classification—that is, a certain tpye of wall will be classified as a "R1 hr., R2 hr., R3 hr. wall" etc. It is expected that ultimately all retardants will be given this classification, and it is felt that when this is finally incorporated as a part of the regular procedure on these devices, the Laboratories' report will be much more used by rating bureaus.

Hardware for Fire Doors

It is expected that the Laboratories will shortly publish a new standard covering the construction of hardware for vertically sliding fire doors. This type of hardware has been before us for some time, but all details have not as yet been settled. The usual reexamination of small hardware devices such as chains, has been carried on throughout the year and it is perhaps worthy of note that the manufacturers of sash chains do not appear to be able to make their chain so that consistent results are obtained in the yearly tests. Variation in ultimate strength of the chains manufactured from year to year appears to be excessive. The Laboratories have tested or had submitted door checks made by practically all the manufacturers of such devices and reexamination on these devices in general indicates that the produce is uniform.

The work of the hydraulic division consisted principally of an increased number of investigations of hydraulic devices, the principal of which were automatic sprinklers, dry pipe and alarm valves and other sprinkler system appliances.

The year was a banner one in so far as investigation of old sprinklers taken from the field is concerned, the number tested being approximately 4,500. Work of this nature shows a tendency to increase as the value of the Laboratories' reports on "old heads" is becoming more and more recognized.

The investigation of breakage of dry pipe valves in the field, started late in 1920, was continued through out the year as opportunity offered, the tests being extended to cover all of the dry pipe valves now on the market. Much valuable information bearing on the subject was obtained and the investigation has resulted in modification of the design of some of the valves.

Several of the inspection departments throughout the country have co-operated with the Laboratories o the extent of sending in copies of all of their reports on field tests of dry pipe valves and some progress has been made in the card indexing of the information thus obtained. It is hoped that eventually all of the information received will be readily available in the form of card records.

Some time has been devoted to the preparation of standards, including the drafting of new ones and the revision of old ones; and there apparently has been a growing demand for specifications covering the more cammon devices and apparatus.

Mainly Constructional

East and West—From Coast to Coast

The 1922 public school building programme, at Toronto, provides for 92 new classrooms, at an estimated cost of $2,711,700 of which total $785,000 is for high schools.

The Hamilton Tar Products Company, of Hamilton, is locating a branch factory to take care of Eastern Canada business, at Ottawa, according to a recent announcement. A very desirable site has been obtained on the old incinerator property, Lee Avenue, with excellent railway facilities. About $50,000 will be spent on new buildings, in which will be manufactured an extensive line of tar products, including pitch and road materials, tar and felt paper, etc.

Vancouver reports the lowest fire loss during the year 1921 of any year since 1915. The value of property destroyed by fire last year was $318,166, of which sum $283,689 was recovered from the insurance companies.

A new organization, the Conductive Mechanical Trade Exchange, incorporated recently at Halifax, has affiliated with the Association of Canadian Building & Construction Industries. Delegates have been appointed to attend the conference at Hamilton, this week.

The annual convention of the Ontario Good Roads Association will be held in the York County Building, Toronto, the first three days in March. An excellent programme is being arranged and will be published in detail in a later issue.

....

It is announced that investigations are being made for suitable sites, on both sides of the Detroit River, for the proposed huge International Bridge from Windsor to Detroit. It is expected that the definite location of the bridge will be made public within the next two months and that an early start will be made on the actual construction in the spring.

A design for a viaduct to bridge the Don valley between the suburban districts of Todmorden and Leaside, near Toronto, was submitted to the York County Council, by the County's engineer, Mr. Frank Barber, at a recent meeting. The bridge, with approaches, would be 1 mile and 20 ft. long. The length of the bridge proper would be 1,400 ft., height 130 ft. and width 56 ft. The estimated cost of such a structure is $870,000.

The report of the International Joint Commission, on the St. Lawrence Waterway project, has been handed to the government authorities at Ottawa and Washington. The report has not yet been made public, but it is thought that the undertaking is favored. Considerable opposition is looked for from the Montreal power interests.

Premier Drury, of Ontario, in a recent address before the Board of Trade at Toronto, advocated the formation of some scheme of unemployment insurance, in the following words:—"When we come out of the trough we must take steps to guard against unemployment. If it finds us unprepared we shall be to blame. I do not know what steps can be taken, but I think a sufficient system of unemployment insurance would help a great deal—a system supported by employer and employee."

It is announced that the contractors and builders of London, Ont., at a recent meeting, decided to reduce the wages of labor approximately 15 per cent, which results in the following new scale:—Plasterers, 85 cents; lathers, 70 cents; carpenters, 70 cents; sheet metal workers, 60 cents; electricians, 60 cents; painters, 60 cents; roofers, 60 cents; laborers, 40 to 45 cents; mill hands, about 10 per cent reduction.

Personal

Jas. A. Wickett Ltd., Contracting Engineers, of Toronto, have moved from room 407, 59 Yonge St. to 16 Saulter St.

Mr. George Turnbull has been re-elected chairman of the reorganized Public Utilities Commission, at Galt, Ont.

Mr. E. J. Curry, plasterer, of Toronto, has moved from the Brass Bldg. to room 203, Gray Dort bldg.

W. M. Wilson, Architect, of St. Catharines, Ont., has opened an office for the practice of architecture at 15 Queen Street.

W. H. Painter was elected president of the Toronto Builders' Exchange & Construction Industries, at the recent annual meeting of this association.

Messrs. Langley & Howland, Architects, of Toronto, have moved from 112 King St. W. to the Gray Dort bldg. corner of King and York sts.

Kaustine Co. Ltd., of Toronto, Water Supply & Sewage Disposal Systems, have moved from 28 Eastern Ave. to 164 Bay St.

Mr. G. Howard Gray has been appointed to the newly created office of Industrial Commissioner, at Weston, Ont. Vigorous efforts will be made to secure new industries for Weston during the present year.

Dr. W. L. McDougald has been appointed chairman of the Montreal Harbor Commission, the other two memberships to be filled later. Dr. McDougald is a well known figure in the business life of Montreal, being president of the Century Coal Company, director of the Hollinger Mines, director of the Dominion Steel Corporation and many other large industrial organizations in Eastern Canada. He is a graduate in Medicine of Queen's University, Kingston, and is the youngest chairman the Montreal Harbor Commission has ever had, being but forty years of age. He was born in Glengarry, Ont.

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Montreal Prepares for an Increase in Construction Business

Montreal contractors and supply firms are looking forward to an increase in business during the current year as compared with 1921. In that period the city building permits gained over 7 million dollars, and the outlying municipalities also had satisfactory increases. No building boom is anticipated in 1922, but rather a substantial growth in volume, particularly in houses. The need is apparent—the difficulty has been that investors have not been inclined to put their money into bricks and mortar and loan companies have not been willing to loosen up. The condition is gradually improving, the loan companies offering money much more freely.

The optimistic feeling is based on a belief that trade conditions generally will be materially better, that prices have reached a fairly stable basis, and that there is more confidence in the commercial situation. The construction industry is a unit in the business fabric, and any advance made in trade as a whole will be reflected in building. It is not expected that costs in Montreal will be lower, or to a very small extent. Although labor was nominally reduced 10 per cent last year, yet the reduction was in fact considerably more, due to the abundant supply of men.

Prospects for 1922

In an interview with a representative of the Contract Record, Mr. Douglas Bremner, president of the Montreal General Contractors' Association, stated: "In 1921 the chief development was not along the lines generally anticipated, that of the construction of industrial plants; the amount of work of this class was negligible. The great bulk of the contracts consisted of schools, residences, apartment houses and a large hotel. As far as I can see, the work in 1922 will again be on those lines. No large industrial establishments are working to capacity, and, speaking generally, increased business can be taken care of in existing buildings. I want to qualify that statement by saying that I look for more construction for industrial purposes, for the reason, I believe, that we shall witness developments which will call for this class of work, but I do not anticipate a very large amount of work. In my view, the public is being educated up to the view that the time has arrived when it should build.

"I do not think there will be any decrease in wages, with one or two exceptions. Labour is down in Montreal pretty much to the pre-war basis. For instance in 1914 carpenters got 45 cents an hour; to-day they receive 50 cents; labourers in 1914 obtained 22½ cents or even 20 cents; to-day the rate is 25 cents. Supplies, with one exception, will probably remain on the present level. It is an interesting fact that in all countries, the largest city pays the highest wages in the building trade, with the exception of Canada, where Montreal pays practically the lowest wages. This is borne out by a comparison of, say, the wages of Montreal, with Ottawa, Toronto, and Vancouver. The cost of construction in Montreal will bear favourable comparison with that of any city in the Dominion."

A considerable amount of work is now on hand, and there are indications that the year's programme will be satisfactory. A number of projects are under consideration, but it will be some little time before anything definite is settled.

More Activity This Year

The Builders' Exchange contemplate a more active campaign this year. A French section has been formed, and for this purpose the constitution has been amended, admitting of four representatives of the French section on the directorate. It is also proposed to form a provincial association, to be known as the Provincial Association of Builders' Exchanges for Quebec. The object and aim of the organization is to protect the building industries of the province by advocating helpful legislation and opposing that which may be considered hurtful; to inculcate just and equitable principles of dealing between contractors, architects and dealers in material, by striving for uniform methods of practice; to provide a means for intelligent consideration and action in wage matters; to maintain a headquarters where information may be had relative to the many subjects of mutual interest to those engaged in the building industries and to cultivate friendly relationship and co-operation between contracors and dealers in the different cities represented in the Association.

Lumber Interests Ask for Fair Competition in Building Materials

Developments may be expected in the near future concerning the proposition to amend the Chicago Building Ordinance covering small house construction in Chicago as recommended by the Joint Committee of the Illinois Society of Architects and the Chicago Chapter of the American Institute of Architects.

The amendment referred to a subcommittee has been the subject of a number of hearings at which

No. 77

Canada's Engineers—H. S. Philips

Mr. H. S. Philips, who recently joined the city engineer's staff of Hamilton, Ont., as sewer designing engineer, is an engineer of very wide experience on water works and sewerage undertakings in Great Britain, Canada and the United States. He was born in Airdrie, Scotland, in 1882 and educated at Wigan High School, Wigan, England, and Heriot-Watt College, Edinburgh, Scotland. His first engineering experience was derived as assistant to J. W. MacLeab, surveyor of Edinburgh. Following this, he became assistant with Marham & Gardner, engineers and surveyors, engaged on quantity surveying and final adjustment of contracts on public works projects. From 1904 to 1907 Mr. Philips was contractor's assistant and construction engineer on the reservoir embankment and first 8 miles of the aqueduct of the Edinburgh water works, (Talla Scheme), Falkirk and Larbet water works, Leith Imperial dock, etc. The Talla scheme referred to was one of the most important of its kind in Great Britain and required 10 years for its completion. For two years following this experience, he was chief assistant to A. & R. MacCulloch, doing surveying and estimating work and he then became contractor's engineer for the Troom Water Works (Loch Bradan scheme), Scotland.

In 1910 Mr. Philips came to this continent and for a short while was assistant engineer to Fowler & Seggelkow, Mount Kisco, N. Y., surveying for the Title Guaranty Company and inspecting sewerage construction. He then joined the main drainage department, of the city of Toronto, Ont., first as draughtsman on storm and relief sewers, then as resident engineer and then as engineer in charge of sewer design, when the major portions of some very large sewerage schemes involving a $5,000,000 expenditure were designed and constructed. These works included sewers ranging in size from 9 ins. to 9 ft. in diameter and twin 6 ft. by 7 ft. A great variety of designs and materials of construction were involved. Surveys, investigations, preliminary plans, reports and estimates were also made for the North Toronto drainage system, with disposal works, outfalls, etc., estimated to cost $6,250,000.

From July to December, 1915, Mr. Philips was temporarily released from his Toronto appointment to become assistant district engineer on the staff of Professor E. B. Phelps, consulting sanitary engineer of the International Joint Commission, in connection with the pollution of boundary waters. Remedial measures were investigated for all the towns and cities on Niagara River, interceptor routes and sites for treatment works being located and studies made of rainfall, population, water consumption and other factors of design. In March, 1916, he left the employ of the city of Toronto to become designing engineer for the Canada Nitro Products, Limited, of Toronto, in which capacity he supervised the design and drawings for a shrapnel loading plant and cordite and gun cotton plants.

For two years following this he held a commission as lieutenant in the Canadian Engineers, in charge of machine gun instruction at the Engineering Training Depot. After his release from the Army, he became assistant to the District Vocational Officer, with the Department of Soldiers' Civil Re-establishment, at Montreal. An appointment as special assistant engineer in connection with the design of sewage and sewerage disposal work, at London, Ont., was accepted by him in May, 1920 which position he retained until November 1921. While in this position, the main outlines for the complete drainage of the city were laid and plans for several sewerage districts, estimated to cost $750,000 were completed. In addition to the carrying out of several schemes, data was collected and plans initiated for the construction of a 10,000,000 gal. per day activated sludge disposal works

Mr. H. S. Philips

Upon relinquishing his position at London, Mr. Philips was appointed designing engineer for the city of Hamilton, in connection with the McKittrick and Homeside sanitary sewerage systems and the $3,000,000 storm sewer program and other projects of a similar nature.

material men and others interested presented their views. A particularly bitter attack on materials other than brick was made December 20 at the committee meeting in the interest of common brick. Among others, Mr. T. F. Laist, Chicago representative of the National Lumber Manufacturers Association, made a reply which in substance was as follows:

"It is said that lumber is combustible and inferior to brick, the material which must be regarded as the standard of all building materials. We have no dispute with brick, we recognize its good qualities and cannot deny its merits as a building material for exterior wall construction or elsewhere.

"It is absurd and unfair to say that the desire on the part of other building material manufacturers to introduce their products on an equal footing with brick, with certain limitations, is an attack on brick. This statement and the one, that we would place protected lumber on a par with brick as a fire resistive

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Cost Keeping on Highway Construction

Contracting Oranizgations and Highway Departments Are Recognizing the Value of Keeping Cost Data—Fundamental Principles of a Successful System

By A. R. LOSH,
Assistant Chief of Construction, U.S. Bureau of Public Roads.

Paper presented before American Good Roads Congress last week.

From an extensive investigation made about six years ago by the Bureau of Public Roads it was found that generally very little cost keeping was done by highway departments on highway work. There was at that time very little interest manifested by public officials in cost keeping on highway work. A similar condition with respect to cost keeping existed to a large extent among road contractors. At this time there had been a long period of uniform conditions with respect to labor, materials, types of construction, and processes. The successful contractor had grown up in the business and had rules and methods of his own for estimating, which were based on years of experience and he did not feel the need of cost statistics. The greater portion of the highway work of the time was done by the type of contractor referred to as having his hat for his office and his check book for his cost record of the job. The more substantial contracting organizations, and especially those which did not confine their operations to road work exclusively, carried cost keeping records on their road work. As a rule, highway engineers attempted to obtain the costs on contract work but generally did not give sufficient attention to the details of cost keeping to obtain complete and reliable data.

Cost-Keeping not Universally Adopted

It has developed from a recent preliminary study of highway cost keeping conditions that there has been a substantial improvement since the investigations, previously referred to were made. Of recent years, due to a scarcity of contractors in the highway field, it has been necessary for government and municipalities to do a large amount of highway work with day labor forces and the value of cost keeping as a check on expenditures and as a guide to efficient management has led to the installation of cost keeping of some kind on this work. In addition to serving these ends much valuable cost data has been accumulated which forms an important part of the fiscal records of the work and has also been used advantageously in placing other work under contract. The advantages of keeping cost on day labor work are generally recognized but there are divergent views with respect to keeping costs on contract work. As a result, it will be found that with one highway department cost keeping on contract work is incidental to the inspection and the resident engineer or inspector is to a considerable extent left to his own devices in this regard, while with another highway department the cost keeping is one of the important functions of the residency and not considered a sideline by any means.

When the cost on contract work is considered advantageously, the method followed is either to select the jobs which will supply the information desired or to cover the entire programme and keep costs on all contracts. In either case there should be sufficient force available to handle the inspection and cost keeping properly. It will be difficult if not impossible to secure satisfactory results unless the inspectors or cost keepers receive specific instructions as to what they are to do, are supplied with standard recording and report forms, and have their cost keeping supervised as well as their inspection work. It is not meant to infer that cost keeping is of the same importance as the inspection of the construction, but that if cost is to be carried on at all it should have more than casual attention from the administrative authorities.

Keeping Cost on Contract Work

The advantages resulting from keeping costs on contract work are usually given as follows:

1st.—Valuable cost data are secured which may be used for estimating purposes.

2nd.—The department has available necessary cost data for making settlement with contractor where unforeseen conditions are involved.

3rd.—Engineers and inspectors receive training in use of cost data and making up of estimates.

4th.—Provides a means for analyzing cost of work which may lead to development of more economical designs and methods.

5th.—In some cases of assistance to the contractor who may not have an adequate cost system.

The Bureau of Public Roads has abandoned the practice of keeping costs on all of its contract jobs but is instead keeping costs on all day labor work and on such contracts where it is thought the data will be advantageous to the Bureau. It will prove advantageous to a highway department to collect cost data on a number of representative contracts each year as a general check on the cost of its designs and also to determine the margin of profit contractors are getting.

Contractors Develop Cost Systems

The increasing use of cost keeping by contractors is even more pronounced than in the case of the public organizations. This is due principally to the unsettled conditions during the past three years which have made estimating more difficult and rendered practically useless many cost data and hypothetical rules used a few years ago. New construction methods, and especially those processes requiring a more extensive use of equipment have also increased the need of cost keeping. Possibly the increasing number of engineers in the contracting field has had some effect in turning contractors to cost keeping. It will be found that highway contractors are now working individually and through their organizations for more systematic and businesslike methods in estimating work and in the keeping of construction costs. While no uniform method for keeping highway costs has as yet been suggested by contractors' organizations, practically all contractors are now keeping costs on their work. Some of the systems used are almost of the check book class in simplicity but they vary from this to a codified system of accounts divided and subdivided to collect cost of labor, materials, equipment and supervision on various operations. It appears that the present tendency is for highway contractors to develop cost keeping systems comparable with those in use by the building industry.

The primary purpose of cost keeping is to ascertain the actual cost of production—not what the cost should be but what it is. For a contractor's use the cost system should furnish reliable data on current costs. In this way a periodical check on the cost of the work, which is an indication of the efficiency of the organization, is available as a managerial aid to the contractor or his superintendent. This function of a cost system is of special value on highway work where there is usually a number of operations under way simultaneously on different parts of the job and in consequence all of the workmen are not continuously under the observation of the superintendent. Next in importance to the contractor is the value of cost data as a guide for estimating future work. The increasing complexity of highway construction is making cost keeping of more importance. The large sums of money now involved in road contracts mean more items of work, new processes, and additional operations over former requirements. To estimate the cost involved without comparable cost data is becoming too costly a hazard. It is not enough to know that there was a net profit on the job, but in order to use the data for estimating purposes the actual cost of production must be known by items and operations.

In the construction industry it is not practicable to determine unit costs with the precision and refinement that obtains in the manufacturing industry. This is due to the variable nature of the construction product and the frequent change of conditions. Also, since conditions are not identical on any two jobs cost data from one is only an approximate comparison for another. For these reasons cost data must be used as a guide or measure in forecasting future costs. Cost data on new or unusual methods of construction and on the use of various plant units are of particular value as similar conditions are likely to be encountered in the future and a basis for cost estimates is available.

Proper Basis for a Cost System

It is believed that the proper basis for a cost system is the four principal elements of cost allocated to the units of production.

A.—Labor costs.
B.—Material costs.
C.—Equipment costs.
D.—Administration costs or general expenses.

The products of highway construction to which these cost elements are assignable are road parts. Fundamentally these parts are:

A.—The right way.
B.—The roadside, shoulders, and grade.
C.—The travelled way or roadway proper.
D.—Drainage channels or ditches and drains.
E.—Drainage structures or bridges and culverts.
F.—Supplementary structures or miscellaneous road parts, such as guard rails, retaining walls, guide posts, etc.

Thus, there are six major products on each of which there may be four elements of expense or costs, consequently, we have 24 cost divisions. Since general expense is not ordinarily ascertained directly on production but is pro rated to the various operations the actual cost divisions with which the cost keeper is directly concerned are reduced to 18. It is believed that this is the minimum number of cost divisions which will provide a satisfactory highway cost keeping system. These cost divisions are susceptible of much further analysis by breaking them up into various operations. For example, a square yard of concrete roadway is one of the unit products. The cost divisions for this are three, i. e., labor, materials, and equipment. To these three may be added the pro rated general expense. For further analysis, this square yard of roadway may be subdivided into subgrade finishing, placing of forms, hauling materials, mixing concrete, placing concrete, curing concrete, etc. This illustrates how the system may be expanded to meet the requirements of any desired analysis.

In placing the cost items against the appropriate construction items the greatest difficulty appears to be in correcting with "equipment costs" and "administration costs." It is the experience of the Bureau of Public Roads on its own work that these items are given less attention in the preparation of estimates and in the segregation of cost to construction items than the more nearly definite items of "labor" and "materials."

Rental Factor

The handling of equipment costs has been greatly simplified by the use of a rental factor computed to cover fixed charges, depreciation, overhauling, lost time, storage, and supervision. In the case of its own plant the Bureau has prepared rental schedules for all units of equipment having a useful life of more than one working season and costing more than twenty-five dollars. Small tools and those which are usually worn out on one job are handled the same as materials. This plan has been in operation three years and except for a change from a monthly to a daily basis it is practically the same as originally developed. It has proven satisfactory on both day labor and contract work of the Bureau. A rental factor of this kind is necessary where current costs are determined for purposes of management. If greater accuracy is desirable for fiscal purposes an annual appraisal of the equipment may be made and the depreciation, repair, storage and other charges pro rated to the projects which have used the equipment.

As general expense is not usually assignable directly to units of construction and many of the expenditures do not come to the attention of the cost keeper on the job, there is a tendency to overlook this element until the project nears completion, at which time the cost is pro rated to the work completed. The result is a sudden jump in unit costs. Even with this apparent defect this may prove the best method to adopt as it greatly simplifies the handling of general expense items. Where limited funds require careful attention to gross expenditure on a project this method is not recommended. Occasionally it is found that the general expense is quite high in starting a job and if this is pro rated to the small accomplishment during the first few weeks of the work, there are shown abnormally high unit costs which are not a true indication of conditions.

Two suggestions are offered for the handling of general expense. First, it will be found advantageous to divide general expense into two parts, one of which includes those costs which are assignable directly to the project and the other the general administration costs of the organization which must be pro rated to all its various projects. This latter part need not be considered in current cost reports as it does not in any way affect the efficiency of the construction organization on the project. This part of the general expense may be apportioned to the project upon its completion. The second suggestion is that the amount of general expense (project) taken up and pro rated on current reports be a percentage of the total probable general expense, which percentage to be not greater than the percentage of the project completed. For example, if the project is only 10 per cent complete, pro rate to completed work be not more than 10 per cent of the total probable general expense. On projects where the cost of "moving in," "camp installations," "organizing," and "disorganizing" is of a considerable amount, the unit construction costs are liable to be materially affected if this entire cost is distributed before the work is well under way.

Basis of a Cost Keeping System

A cost keeping system to be successful must be based on certain fundamental principles. First of all, it must be designed to furnish the particular information sought. This feature cannot be too strongly emphasized as not infrequently much more time is spent in perfecting quasi-scientific forms, codes, and procedure than is given to working out a system for getting at the cost of doing work. The system devised must be reliable and accurate to a practical extent. Insofar as field procedure is concerned, simplicity is a very important consideration and it should be such that the required data can be successfully compiled by foremen and timekeepers. The effectiveness of the system will depend to a great extent on the celerity with which the unit costs may be ascertained. Unless the cost of doing the work can be determined easily and promptly its value as an aid to efficient management is lost. Some consideration should be given to making the cost system adaptable to the general work of the organization and not design it entirely for an individual job or set of conditions. It requires time and considerable patience to get a system in working order and frequent changes in forms and instructions should be avoided as they are generally disconcerting to the men in charge of construction work. It must be understood that cost keeping ties in the general bookkeeping scheme of the organization and is not to be operated independent of the regular accounting. While the cost-keeper and bookkeeper makes different use of the information, the basic data used should be the same.

One of the reasons cost keeping has not received more encouragement in the past from engineers and contractors has been the question of its cost. A system laid out along the lines indicated and designed to give the information needed for the proper supervision or administration of the work of an organization need not be expensive considering the volume of business it handles. It is when a system is developed beyond the requirements of the organization that cost becomes an important consideration.

A review of the present status of cost keeping on highway work indicates that it is still very much in a formative stage. There are some excellent systems in operation in many of the highway departments and among the larger contracting organizations, but on the larger part of the extensive highway program cost keeping as practised leaves much to be desired. A great step forward would be accomplished by a general classification of cost keeping terms. Many of these as not used are subject to several interpretations. Engineers and accountants could materially improve the situation by reaching a common understanding in this regard.

As an indication of the present interest in highway cost keeping it is interesting to note that since the publication by the Bureau of Public Roads of its Cost Keeping Bulletin more than five thousand copies have been distributed.

Lumber Interests Ask for Fair Competition in Building Materials

(Continued from page 78)

material, is misleading and detracts attention from the main point at issue.

"The proposition that we uphold and which did not orginate with the lumber industry but from an independent and unbiased, reputable organization of scientific and well qualified experts is this:

"That a one and one-half story house with walls not over 15-½ feet high and not to exceed 1200 sq. feet in area be permitted of wood construction provided the exterior walls be covered with metal lath and portland cement and providing further, that the buildings be not placed within three feet of any lot line.

"The recommendation that this construction be permitted within the fire limits is for the reason that the fire limits of Chicago have been extended into districts which might almost be termed rural. The use of this construction would, because of the limitations placed upon it, never be used in congested districts.

"The lumber industry is not interested from a selfish motive in promoting this type of construction. The interest of this industry lies particularly in the encourgement of building of all kinds along reasonable lines and this, I believe, is the motive which promoted the suggestion of this, and other types of construction by the architects. Their recommendations were based on recent and authoritative tests made by the Fire Underwriters and the United States Bureau of Standards as to fire resistive qualities of metal lath when properly imbedded in portland cement as a protective covering for wood.

"We are not interested directly in other materials that have been suggested such as concrete and hollow tile and which are included in this attack—they can speak for themselves—but I wish to say that we do believe that these and other materials should be recommended with this proviso, providing they do not unduly hazard life and property. The house owner should be permitted a choice of material, thus competition would be stimulated.

"Much has been made of the fact that the insurance rate of a stucco house is higher than that of a brick house. The difference in dollars per annum to the owner of a stucco house would be considerably less than the interest on $100.00. If he chooses to have a stucco house and pay this difference I can see no reason why he should not be permitted to do so. It has been admitted that the erection of a stucco house along side of a brick house does not add to the insurance that the owner of the brick house has to pay.

The Fourth Canadian Construction Conference the Greatest in the Annals of the Industry

Four-Day Meeting in Hamilton, Ont., Attracts the Largest Attendance on Record and Carries Through Important Business Affecting Contracting Interests—A Full Report of the Proceedings and Attendance

Without wasting time with preliminaries, the Association of Canadian Building & Construction Industries opened their fourth annual construction conference, in Hamilton, Ont., on January 17, by getting right down to business with a thoroughness and eagerness that augured well for the attainment of some tangible results and the formulation of a definite line of action for the improvement and stabilizing of the whole building industry. While the first general session was not scheduled until the afternoon of the first day, the national council of the association met earlier in order to draft the personnel of the various committees, and thereby save time in the general meeting. These committees, which were submitted to and approved by the meeting as a whole, were:

Publicity—E. B. Osborne and Frank Magee.

Finance—J. M. Pigott, E. G. M. Cape, A. E. Hamilton, John V. Gray and A. G. Bonnett.

Conference Arrangements—Frank Magee, J, M, Pigott, John Grieve and E. B. Osborne.

Resolutions or New Business—J. P. Anglin, J. M. Pigott, E. S. Mattice, John Grieve, Wm. Wilson, G. H. Whitlock, James Mackie and J. B. Carswell.

Labor—J. B. Carswell, R. J. Fuller, Jas. Mackie, Wm. Wilson, J. M. Pigott, J. C. Harris, S. E. Dinsmore and E. G. M. Cape.

Business Relations and Standard Practices—G. H. Whitlock, F. Newby, E. S. Mattice, H. J. Bird, A. G. Bonnett, A. A. McDonald, W. A. Craik, W. A. Wilson and John V. Gray.

The nominating committee was appointed by J. P. Anglin, president of the association, and according to the constitution was composed of one delegate from each province represented at the convention. The personnel of the committee was as follows: Messrs. A. A. McDonald, Crawford, E. S. Mattice Frank Magee, Jas. Mackie and G. H. Whitlock.

The official welcome to the association and its delegates was given during a luncheon prior to the first general session, Mayor Coppley of Hamilton and Col. B. O. Hooper of the Hamilton Chamber of Commerce extending greetings to the representatives of the construction industry. In their addresses of welcome, these speakers emphasized the importance of the building business and expressed confidence that the convention would be the means of determining a line of action that would stabilize the industry and give it an impetus during the present year.

Routine business occupied the first part of the general session and was quickly disposed of. The minutes of the last annual convention, held in Winnipeg, were adopted as printed in the Contract Record. A request from the city of Windsor, Ont., to hold the 1923 convention of the association in that city was referred to the executive to be dealt with along with any other requests of a similar nature. Greetings were received from the Associated General Contractors of America, the National Federation of Construction Industries and many contractors throughout Canada who found it impossible to attend the meeting.

The Secretary's Report

The report of Mr. J. Clark Reilly, the executive secretary of the A. C. B. C. I., was very complete and detailed in its presentation of the past year's activities of the association, but it also went further in suggesting certain lines of action for the present season. In Mr. Reilly's introduction, he commented on the trying conditions of the past year and how these circumstances have been reflected in the reduced finances of the organization, some members feeling it necessary to reduce or cancel their memberships. In spite of this curtailment of funds, a small balance on the right side had accrued. The work accomplished by the association and suggestions for future activities were further outlined in the following abstract of the report.

"The hard work of the pioneers in the formation of this Association is beginning to bear fruit. Following our Winnipeg Conference in January last, the men in Manitoba, Saskatchewan and Alberta got together, and formed a Western Branch, which will meet again in March. In the Province of Quebec, a Provincial Association has been formed, fathered by Mr. K. D. Church and Mr. E. G. Brousseau, Branch Associations have been formed at Port Arthur and Fort William, and at Prince Albert.

"At the conference in Winnipeg, a number of questions were sent forward to the Executive for action, and these have been dealt with, so far as was possible under conditions existing in the industry during the year.

"It was not found practicable to employ an associate secretary, to devote his time to the interests of the manufacturing and supply section, and the trade contractors' section, owing to the lack of the required funds.

"For similar reasons, the membership campaign, instituted last year, was dropped by mutual consent early this year. This conference should be prepared to discuss methods for ensuring the future work of the Association with a sufficient financial backing.

"The question of housing, acted on by resolution at Winnipeg, has been carried forward by the executive to the government, but the difficulty of financing such a scheme proved to be the stumbling block in the way of its success. The need still exists.

"The National Joint Conference Board, of which last year's conference approved, has held five meetings, as follows:—first in Ottawa, March 2nd and 3rd; second, third and fourth, during the Joint Conference in May; fifth in Ottawa, delayed meeting from December, held January 10th. The recommendation regarding financing this Board has not as yet been acted upon, our members continuing to pay their own expenses.

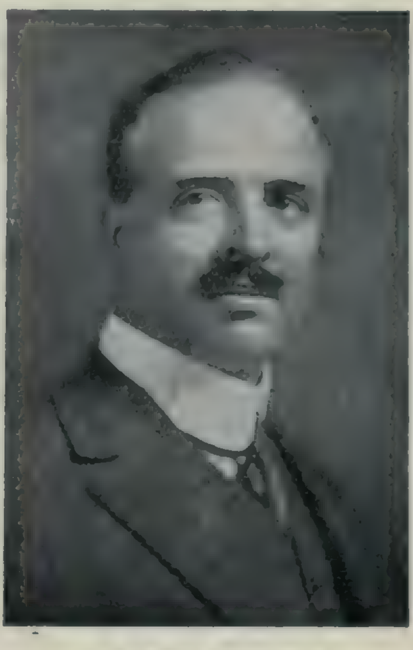
"A joint conference in the building and construction industry of Canada was held at Ottawa, May 3rd to 6th, on the invitation of the Minister of Labor, who acted at the suggestion of the National Joint Conference Board. Some thirty-two employers' delegates from all parts of Canada met a similar number of representatives of organized labor.

"Apprenticeship is still a question on which but little practical results are apparent, in the working out of the schemes proposed for national and local councils, and also in the actual signing on of boys for the trades in the industry. The foundations have been laid, however, and when conditions improve, the need of apprentices will be more strongly felt than ever.

Officers of the A. C. B. C. I. for 1922

Mr. J. B. Carswell, president

Mr. Jas. Mackie, 1st vice-president


J. P. Anglin, past-president

"The resolutions of last year's standard practices committee were sent out to branch organizations throughout the country, and have been discussed and acted upon in some places. There does not seem to have been any very special enthusiasm over establishing rigid codes of practices, and yet difficulties constantly arise in the relations of general contractor and sub-contractor, and of both to the supply-man.

"Representations were made to the Dominion and provincial governments in regard to the re-imbursement of contractors who had suffered loss owing to war conditions, and also in reference to the resumption of public works to relieve unemployment.

"Joint consideration, with the executive committee of the Ontario provincial association, was given to the question of the Ontario Lien Law, and other legislation affecting our industry coming before the provincial legislature.

"The standard contract documents approved at last Conference have been placed before the Royal Architectural Institute of Canada and the Engineering Institute of Canada, for their approval, but these bodies apparently do not wish to take action at present. Copies have been typewritten and distributed on request, and the general conditions and straight contract have been used on some large contracts, and found practical and satisfactory. The executive suggest that this conference should consider the advisability of having them printed, and placed on sale. It has also been suggested that we might consider some standard form of bulk purchasing order, this being in the nature of a contract form.

"The experience of the past year in the Joint Conference Board has shown the need for the discussion of basic principles to govern the mutual relations of employers and employees in our industry. Our suggestions in this direction ought to be made quite clear, at this time.

"The Association was represented by the president at the annual meeting of the Employment Service Council of Canada, at which the question of unemployment was the principal subject under discussion. The Dominion Government, in conjunction with the provincial government and municipal authorities, is carrying out some of the suggested plans of this Board. There is still a great measure of unemployment in the large centres of Canada, and as an association we should give the most careful consideration to this very pressing problem.

"The question of freight rates is still with us. Some relief has been given to conditions by the reduction allowed by the Board of Railway Commissioners, but there remains much to be said and done in regard to the rates on heavy commodities, in which the construction industry is so directly concerned.

"It is to be noted that the branch organizations are making increasing use of the secretary in Ottawa to secure information from various offices of the government, and this is also the case with individual members of the association. The secretary has tried to keep in touch with matters which have come up, affecting the interests of the association, both in the late session of the House, and in the resulting application of the legislation.

"One of the needs felt by the executive and the secretary is the obtaining of statistics dealing with various questions which arise, and which we have not the facilities for obtaining. This is a question which will have to be carefully considered.

"There is still the necessity for the uniformity of legislation in the various provinces of Canada. This is specially true of the Workmen's Compensation and the Lien Acts.

"We must also consider carefully the question of a special sub-executive for the West, and Western standing committees. There are problems constantly arising which require special action in the West, suited to the local conditions, which in many instances are quite different from those experienced in the East. At the same time, the fundamental principles are the same, and there ought to be the very closest co-operation and relationship.

"This will also suggest the necessity for some plan being arranged for the equalization of travelling expenses of delegates to our Conferences. Some scheme ought to be feasible which would distribute the burden equitably, and provide for a larger representation from the more distant points.

"Speaking generally, the year 1921 has been a very notable one for building and construction in one respect at least. The attention of the various governments, the press, the pulpit and the public has been directed very intensely towards the industry, both in the United States and Canada. This has been due in a large extent, to the wide-spread publicity given to three outstanding reports, viz., The Lockwood inquiry in New York City, the report of Judge Landis in Chicago, and what is known as the Hoover report on the elimination of waste.

"Through these reports, and the resulting discussion and other more direct and practical effects, public interest has been aroused in practically all of the great questions which we have had before us. The causes for the high cost of labor and materials, the shortage of housing, the seasonal character of the industry, the tightness of money, the attitude of labor organizations, the results of agreements between employers and organized labor, the causes of waste, and the need for greater stability and standardization have all been under discussion.

"The Hoover report contains some clauses which are very striking, and which may be found applicable to Canadian conditions:—

'Waste, it is said, is causing huge losses in building, which including all trades and labor incidental to it, ranks second among the industries.

'The chief sources of waste in the building industry are:— irregular employment, inefficient management and wasteful labor conditions. Customs or conditions prevailing throughout the industry and poorly designed equipment are given as secondary causes.'

'A striking fact about the building industry is that inasmuch as small buildings require so little capital and credit, and apparently so little technical ability, the field is full of small contractors, many of whom operate for a few years, and then fail.'

'Wasteful labor regulations, according to the report, consist of requiring skilled men to do work which could be done by unskilled, restricting individual incentive through requiring uniform wages, limiting the number of apprentices, excessive reduction of working hours, restricting output by prohibiting the use of labor-saving devices, and jurisdictional regulations.'

"We in the fourth conference of the association are faced with these questions, and others equally serious. Our sessions will be watched with interest by people in all parts of Canada who are interested in building homes, schools and other public buildings, factories and office buildings. The responsibility in which we share is well emphasized by the following clause in the general manager's address, at the recent 55th annual meeting of the Canadian Bank of Commerce:—

'The excessive cost of building operations has made it impossible up to the present time to embark on an operation of such magnitude as is necessary to meet our requirements. In this connection it may be pointed out that in all parts of Canada there is a large programme of building in prospect, the carrying out of which only awaits more stable conditions in the form of lower prices for material and labor and a return to efficiency.'

"The past year has been a time of difficulty and uncertainty, but it is our business to face the future with confidence and courage, and do our utmost to solve the problems, and bring about a return of those conditions which will mean a revival of activity in our industry."

* * *

New Funds Needed

The treasurer's report, presented by J. M. Pigott, honorary treasurer, showed a total income of $7,681.48 and a total expenditure of $7,659.88, leaving a balance of $21.60. In commenting on this report, Mr. Pigott pointed out that the income for the year was very considerably less than the totals shown in the statement of the previous year. This was explained by the fact that in 1920 a membership campaign, conducted on a commission basis, was put on. While there might be some criticism of the method used to raise the money in 1920, the fact remained—as evidenced by the receipts this past year—that finances would not come in properly of themselves. That the finances of the association should be placed on an adequate and sound basis was advocated by the honorary treasurer, whose report in this connection read as follows:—

"This conference should very carefully consider the whole question of financing the work of the association. Up to the present time, two or three of the largest centres have been carrying the great proportion of the burden, and the others have not been doing their share.

"Some arrangement should be made, whereby a man may be engaged, either on salary or commission basis, to visit the various centres, and see that the field is properly covered.

"The work of the association is steadily growing in importance, and the finances ought to be placed on an adequate and sound plan, which will provide for the present expenditures and also for necessary expansion in the future."

High Freight Rates

Following the presentation of the above reports, the committees previously named were approved. At the suggestion of Mr. R. J. Fuller, supported by Mr. G. H. Whitlock, it was decided that the high rates pertaining to construction materials and more particularly to the transport of contractors' plant should be earnestly considered by the association. The resolution and new business committee was, therefore, empowered to elect a new sub-committee to consider this important contracting problem.

* * *

President's Address

J. P. Anglin's presidential address was full of optimism in regard to the future of building operations in Canada. The business tide had turned and from now on he looked for a big improvement in the construction industry. The part that the association of Canadian Building and Construction Industries would play in this development was considered by Mr. Anglin to be an important factor, for the association had now reached a position where it was a strong force and would make its influence widely felt. Through many publicity channels the A. C. B. C. I. had now become known to the public, with the result that the construction industry was more constantly in people's minds than ever before.

Mr. Anglin briefly outlined some of the outstanding problems of the association and its members, placing the labor question foremost as the most important matter to be solved. In a short outline of the relations that had existed during the past year between building contactors and their employees, he mentioned the practical failure of the National Joint Conference Board and the Joint Industrial Councils to function according to the anticipated plan. The blame for this was laid largely at the feet of the business agents who were considered buffers between the employers and the unions preventing the real sentiments of the tradesmen from finding expression. Mr. Anglin felt that this whole problem should be thoroughly aired and a definite and final line of action determined.

Other Contracting Problems

The president also regarded unemployment as a serious problem, requiring some attention from the convention, although he did not agree with the seemingly current opinion that resumption of building alone was a cure-all for unemployment. An impetus to construction could, undoubtedly, do much toward providing work but it could never create work for mechanics in other lines of industry who might be out of employment. Mr. Anglin urged, as an integral part of the unemployment problem, that some attempt should be made to take away the seasonal character from construction.

The president also asked that the building materials situation be handled definitely. He felt that further concession in the prices of these commodities was desirable and warranted and for that reason urged a thorough investigation into the whole matter.

In conclusion, the president summarized the trend which, in his opinion, building costs would take. He said that the general contractors would do their best to get the cost of building down to the level which the public desired. The public was looking to contractors for a further lowering of prices and in consequence, the contractors were taking a lower percentage of profits than they had ever done before.

Labor Question Regarded as Important

Other members of the executive addressed the conference, commenting on the important problems to be discussed. Mr. Jas. Mackie, for one, urged some action to off-set labor domination, which was the trouble to-day. He regarded the attempts so far developed to combat this evil as merely playing with the question. In handling these and other matters, however, he felt that above all, the interests of the public should be safeguarded. Mr. Pigott, characterized industrial councils and the National Joint Conference Board as buffers protecting the labor men. Such conferences had no effect on the men and therefore, in his opinion, were superfluous.

A complete review of the whole labor situation was presented by J. B. Carswell, first vice-president and chairman of the labor committee. He first summarized briefly the accomplishments of the National Joint Conference held in Ottawa last May, referring to the undercurrent that was prevalent during the proceedings and which nearly broke up the meeting. The effect of this was that until January 10, 1922, no further meetings of the National Joint Conference Board took place. On that date, however, a session of that Board was arranged with a view to bringing down some points for consideration at the A. C. B. C. I. conference. In order to get some tangible results, the A. C. B. C. I. representatives on the National Joint Conference Board suggested some basic principles governing the relations between employers and employees in the building industry. These principles were not, however, endorsed in whole by the labor side. The employers' suggestions were as follows:

Employers' Suggestions

It is realized to-day by public-spirited employers and workmen that their mutual interests should be considered in a spirit of co-operation. In order to be lasting and beneficial, such co-operation must admit certain fundamental rights of both employers and the employed, and be carried out by both in the spirit of fair play.

Co-operative efforts have been attempted in the building and construction industry of Canada, by the establishment of local joint industrial councils in several centres, and the formation of a National Joint Conference Board. In order that these efforts may be such as are likely to lead to satisfactory results, it is felt that certain principles should be accepted by both employers and employees, as governing, as far as possible, the specific questions which may come before the councils for consideration.

The following principles are therefore considered to be of basic importance in these efforts to co-operation in the building and construction industry:

1. No business can last unless there be a substantial accumulation of reserves in order to provide for expansion, periods of depression, and unfortunate experiences involving loss.

On the other hand employees are justly entitled to expect a remuneration for their services which is more than sufficient to provide for a mere existence, and which will enable them to accumulate a surplus to meet contingencies.

2. In localities where any particular labor organization or organizations are in the ascendancy, it is wise and expedient for employers, and the employees representing such organization or organizations to enter into agreements, the objects of which will be to stabilize the industry. But it must be recognized

that every individual should have the unrestricted right to work where and with whom he chooses, irrespective of his affiliations with labor organizations.

3. Labor organizations who effect agreements with employers, should not endeavor to make use of this relationship to the disadvantage of such employers, in order to wrest advantages from employers who do not make such agreements with labor organizations.

On the other hand, employers having agreements with labor organizations should be entitled to expect that work performed should be carried on with increased efficiency.

The combined efforts of both parties should be exerted to increase and stabilize the earning power of both employers and employees.

4. There should be no discrimination against either employer or employee in a locality where no trouble exists, because of the collective action of his organization in another locality.

5. The best efforts of both employers and employees should be directed to the elimination of jurisdictional disputes.

On the Executive of the A. C. B. C. I. for 1922

Mr. E. G. M. Cape, honorary treasurer

Mr. J. M. Pigott, chairman, general contractors' section

Mr. E. G. Brousseau, chairman, trade contractors' section

6. The general principles of arbitration should be the basis of settling all disputes. If the work of the local joint industrial councils is to be effective, each party should agree to submit disputes to arbitration and refrain from making use of lock-out or strike until the lapse of a specified period after the recommendation of the board of arbitration has been made.

7. Special encouragement should be given to apprenticeship and the formation of local joint councils.

The foregoing principles are those that may be held to apply to existing conditions and any change in these conditions that the future may bring forth may warrant their modification or amendment.

Suggestions by Labor Side

The labor side accepted the above only on the basis of the following changes and suggestions.

Agreed to preamble and Principle No. 1.

Wished to substitute the following for Principle No. 2;—

For the successful operation of the building industry in all localities, it is fully recognized as being both wise and expedient, and in the best interests of both employers and employees, that mutual agreements be made governing wages, hours of labor and working conditions.

Wished to substitute the following for Principle No 3:—

All agreements entered into between employers and employees should be observed to the fullest extent, both in spirit and letter, and where such agreements exist, all work should be carried on with a view of increasing efficiency, stabilizing the industry and removing all sources of friction.

Disagreed entirely with Principle No. 4.

Agreed to Principle No. 5.

Wished to substitute the following for Principle No. 6:—

The general principles of collective bargaining and direct negotiation between employers and employees, through their respective organizations, shall be the recognized basis of reaching agreements. Should this mode of procedure fail, it is agreed that the whole matter should be submitted to conciliation and arbitration under the Industrial Disputes Act, or to such mutual arbitration as agreed upon by both parties to the disputes, and no strike or lock-out shall take place during the period of such action.

Agreed to No. 7 and conclusion.

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SECTIONAL MEETINGS

In the evening of the first day of the convention, the general contractors, trade contractors and supply men held separate sectional sessions to discuss the particular problems of each section. One outcome was the appointment by each section of a committee of three to work together to discuss ways of getting the co-operation of the sections so that members of the association, rather than outsiders, might be favored in any business dealings which members may have. The general contractors also picked out a committee, consisting of Messrs. Foley, McLeod, Stuart, Anglin, Bonnett, Gibb and Craik, to consider the activities of the section and report back at a later meeting.

* * * *

SECOND DAY

Outlook for 1922

The feature of the morning session on the second day of the conference was an address by Mr. H. N. McGill of the well-known firm of Roger Babson, statisticians, on the outlook for 1922. By means of facts and figures such as are used in the Babson service, Mr. McGill demonstrated the probable trend in the general industrial situation for the present year, and more particularly in the construction field. The inter-relationship of one country with another was first emphasized, it being pointed out that when either good or bad conditions exist in one country, the same circumstances are reflected in other parts of the world. General trade conditions always operated in cycles, decline and depression always following prosperity with unfailing regularity. To determine the trend of these cycles, Babson's used twelve distinct barometers, the composite of which was used to determine the condition of the industrial world as a whole.

Mr. McGill outlined the trend of the cycle operating at the present time, and in forecasting for 1922, differentiated the factors into pessimistic and optimistic. In the latter category were the facts that financial conditions were sound in Canada and the United States, that nationalization of advertising was an established fact, that standardization of merchandise had been attained, and that the largest portion of our resources were still awaiting development. On the other hand, there were over-capacity of industrial facilities, an abnormal number of business failures which would continue through this year, a serious unemployment situation, wages that are still too high, a need for readjusted transportation costs and a badly mixed-up situation in Europe. For these reasons Mr. McGill's opinion was that the recovery from the present period of depression would be very slow during 1922.

Tendency in Prices

He declared that no normal exchange of commodities could take place while some prices were too high, some too low and some in between. The recovery that was in evidence at the present time was primarily a seasonal change and not a fundamental one. After a thorough analysis of all the factors involved the speaker came to the conclusion that in the spring we could expect slightly higher prices, followed by decline in summer, with a picking up again in the fall.

Speaking of building in particular, Mr. McGill felt that there was a very unbalanced condition, with prices of materials ranging from 10% to over 100% above pre-war prices. Until this abnormal situation could be remedied he could see no hope of a more balanced condition of affairs. The cost of industrial building was only 68% above 1913, while the cost of residential building was 100%. It was his prophecy that there would not be a great deal of industrial building, which had already been over expanded, but there would be a fair amount of residential building, although there were certain factors tending to impede even this type of construction.

At the luncheon on the second day, Mr. J. Grove Smith, Dominion Fire Commissioner, was the speaker. He spoke on the contracting business from an ideal viewpoint, emphasizing the high principles that should govern the constructor's operations.

Papers on Construction Subjects

During the afternoon of January 18, two important papers were presented. The first, on "Contract Bonds," by Mr. W. H. Hall, of the Canadian Surety Co., outlined the advantages of bonds guaranteeing completion of contracts, particularly when the surety was corporate and not personal. This paper is reprinted elsewhere in this issue.

The building situation in Canada for 1922 was the topic of a paper by Mr. A. R. Whittemore, manager of MacLean Building Reports, Ltd. A very encouraging forecast was presented, greater activity in building being expected this year. In summary, Mr. Whittemore characterized 1922 as a year of recuperation, 1921 having been a year of liquidation.

Freight rates were discussed by Mr. F. B. McFarren, of the Interprovincial Brick Co., Limited. According to his data, the manufacturers of building supplies had been placed in a very unfair position by the railroads, and discrimination had been shown against certain building commodities, although they were very cheap materials to handle and very profitable for the railroads. A reduction in rates, in Mr. McFarren's opinion, would stimulate building and also prove profitable for the railroads through the greater number of car movements that would result.

No meeting was scheduled for the evening of January 18, the delegates being entertained instead at the theatre or the hockey match.

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THIRD DAY

The morning session of the third day of the conference, January 19, was largely taken up with a comprehensive paper on "Construction Costs" by W. N. Connor of the Aberthaw Construction Co., Boston, which paper will be reprinted in abstract in a future issue.

Following this paper, the conference went into a committee of the whole to discuss the labor question. As a basis of discussion, the Committee on Labor brought in a tentative report containing suggestions which it desired to have thoroughly discussed. At the close of the session this discussion was adjourned until the evening meeting.

At noon, Hon. Mr. W. Rollo, Minister of Labor for Ontario, was the guest. In his speech he described what the provincial and Dominion governments were doing toward relieving unemployment. He also discussed workmen's compensation, safety measures, unemployment insurance and other matters of interest to the construction industry.

Trips to Plants

In the afternoon the delegates were entertained by the supplymen and taken to jobs and plants of interest. Among the works visited were the Burlington Canal bridge erected by the Hamilton Bridge Co., the National Fireproofing Co.'s plant, the Canadian Libby-

Owens Co.'s plant, the Burlington Steel Co.'s plant, the Ontario Gypsum Co.'s works, and others.

The Labor Question Again

The evening session was devoted to a discussion of the labor problem, many delegates contributing their views on the matters suggested in the tentative report of the Committee on Labor. A special address on the question was given by Mr. J. E. Sweeny, of Detroit, who outlined the labor situation in the State of Michigan. At the present time in that state, the optional form of employment is in force and is meeting with huge success. After discussion of the question, the delegates instructed the Committee on Labor to bring in a final report for presentation to the convention.

The evening session closed with an interesting address and instructive film on "Fire Waste in Canada," by J. Grove Smith, Dominion Fire Commissioner.

* * *

FOURTH DAY

A meeting of the Canadian General Contractors' Association, operating as a section of the Association of Canadian Building and Construction Industries, was held at 9 a.m., January 20, 1922. Mr. Wilson occupied the chair.

The committee appointed at the previous meeting reported, and on motion by Mr. Anglin, seconded by Mr. Stewart, the report was discussed clause by clause.

It was moved by Mr. Gray, seconded by Mr. Stewart, that it be recommended to the executive of the Association of Canadian Building and Construction Industries that general contractors applying for membership in the Association of Canadian Building and Construction Industries be referred to the executive of this section before being accepted as members.

That for guidance of the executive in passing on applications for membership, we lay down as cardinal qualifiactions:

(1) Personal integrity.
(2) Experience.
(3) Financial responsibility.

It was moved by Mr. Stewart, seconded by Mr. Craig, that this section recommend to the executive of the Association of Canadian Building and Construction Industries the adoption of some insignia or seal for use on signs and stationery signifying membership in this association.

Mr. Anglin proposed that Mr. Pigott be chairman of this section for the ensuing year there being no further nominations, the election was declared unanimous by the chair.

It was moved by Mr. Anglin, seconded by Mr. Fuller, and carried, that Messrs. Pigott, Dinsmore, Wilson and McLeod be a committee to appoint two members of the section, who will, together with the chairman of the section, form an eastern executive of the section.

It was moved by Mr. Anglin, seconded by Mr. Fuller, and carried, that Mr. Craig, Mr. Wilson and Mr. Bennett form a committee to appoint three members of the section who will form a western executive of the section.

There being no further business the meeting was adjourned.

* * *

The session of the whole conference commenced at 10 a.m. Several resolutions were presented and carried, the first, moved by Mr. R. J. Fuller, being that the association appoint a standing committee to consider the whole matter of estimating and cost keeping and to devise a system and prepare forms for the use of the members of the association. Another resolution provided for the amendment of the by-laws to provide for a western executive of the association, to consist of one vice-president who must always be a westerner, four members chosen at the annual meeting and four selected by the provincial organizations. This resolution was adopted.

J. M. Pigott moved that the A.C.B.C.I. endorse the stand of the Ontario Provincial Builders' and Supply Association in their opposition to proposed amendments to the Ontario Lien Act. The matter was referred to the executive with full power to act.

Mr. Hamilton made a recommendation that at future conferences, business be started early and not interfered with by the social side of the convention, and that duplication be avoided in the personnel of committees. This recommendation was referred to the executive.

The tentative freight committee was made a standing committee in order that a thorough investigation of freight rates might be made.

* * *

The following report of the committee on standard practices, presented by W. A. Wilson, was adopted:

1. Standard Contract Forms.

Having gone carefully into the correspondence relating to this form of contract, which is the result of certain recommendations of your committee at the Winnipeg conference, when the form was adopted, we find nothing in this correspondence that would justify making any alterations; we would, therefore, recommend that the executive of this association at an early date consider ways and means of having these forms printed and distributed to the several exchanges, for the use of its members, and they as members of this association do all in their power to have these forms of contract adopted for general use by all architects, engineers and public bodies. Also that an adequate unit price per copy be charged to cover the cost of producing same.

2. Cost-Plus Contract Forms.

Your committee would recommend that, owing to the heavy expense involved in printing this document, it be placed at the disposal of the members through their exchanges in such form as the executive may decide, as we are of the opinion it would be a guide to the members entering into this form of contract.

3. Standard Practices.

We feel that we cannot enlarge on the very comprehensive report and recommendations brought in by the special committee at our last conference, unless it be to further strongly recommend that, as these standard practices depend to a large extent, as to their adoption and enforcement (if only in spirit) on a spirit of friendliness and good fellowship, the social side of all local associations and exchange work be given more attention and as far as possible some form of entertainment should be introduced at least once a month, so as to foster and encourage this friendship and good fellowship to the fullest extent.

* * *

Mr. N. McLeod presented the suggestions contained in the report above of the Canadian General Contractors' Association. These recommendations were referred to the executive.

* * *

Mr. Carswell presented the following resolution, which was passed at a joint committee meeting of three sub-committees representing the three sections of the association. The resolution was adopted.

1. That a badge or seal be at once prepared for the common use of all members of the association and that the seal be copyrighted.

2. That a small charge, the amount of which is left with the executive, be made for the use of this seal and the necessary die and that every application for a seal be passed upon by the executive of the local branch or affiliated body, where such exists in the applicant's locality, and further that both such executives must endorse the application before granted.

3. That this seal be used on the stationery of the grantee.

4. That in granting the right to use this seal the executive or executives should scrutinize carefully the integrity, the ability and the responsibility, financial and otherwise, of the applicant, and that power be given the executives to withdraw the right to use this seal for cause.

5. That it be established as a guiding principle to the members of this association as between section and section, that they recognize this seal by working together toward their common advantage.

* * *

LABOR REPORT

The following is the report of Labor Committee which was adopted:

Clause 1—Basic Principles

Resolved, that the basic principles herein enunciated should be adopted.

It is realized to-day by public-spirited employers and workmen that their mutual interests should be considered in a spirit of co-operation. In order to be lasting and beneficial, such co-operation must admit certain fundamental rights of both employers and the employed, and be carried out by both in the spirit of fair play.

Co-operative efforts have been attempted in the building and construction industry of Canada, and in order that these efforts may be such as are likely to lead to satisfactory results, it is felt that certain principles should be accepted by both employers and employees, as governing, as far as possible, the specific questions which may come before the councils for consideration.

The following principles are therefore considered to be of basic importance in these efforts to co-operation in the building and construction industry.

1. No business can last unless there be a substantial accumulation of reserves in order to provide for expansion, periods of depression, and unfortunate experiences involving loss.

On the other hand, employees are justly entitled to expect a remuneration for their services which is more than sufficient to provide for a mere existence, and which will enable them to accumulate a surplus to meet contingencies, always provided that efficient service has been rendered.

2. In localities where any particular labor organization or organizations are in the ascendancy, it is wise and expedient for employers, and the employees representing such organization or organizations to enter into agreement, the objects of which will be to stabilize the industry. But it must be recognized that every individual should have the unrestricted right to work where and with whom he chooses, irrespective of his affiliations with labor organizations.

3. Labor organizations who effect agreements with employers should not endeavor to make use of this relationship to the disadvantage of such employers, in order to wrest advantages from employers who do not make such agreements with labor organizations.

The combined efforts of both parties should be exerted to increase and stabilize the earning power of both employers and employees.

4. There should be no discrimination against either employer or employee in a locality where no trouble exists, because of the collective action of his organization in another locality.

5. The best efforts of both employers and employees should be directed to the elimination of jurisdictional disputes.

6. The general principles of arbitration should be the basis of settling all disputes. Each party should agree to submit disputes to arbitration and refrain from making use of lock-out or strike until the lapse of a specified period after the recommendation of the Board of Arbitration has been made.

7. Special encouragement should be given to apprenticeship and the formation of local joint councils.

The foregoing principles are those that may be held to apply to existing conditions and any changes in these conditions that the future may bring forth may warrant their modification or amendment.

Clause 2—Business Agent

Resolved, that in the common interest of the public, the employee and the employer, the policy of this association shall be to deal directly with the actual employees rather than with business agents.

Executive Secretary of the A. C. B. C. I.

Mr. J. Clark Reilly.

Clause 3—Agreements

Resolved, that when any agreements are reached with labor that these be reduced to writing and that they should only cover wages and hours of work having in view the stabilizing of rates, and that the basic principles enunciated above should find expression in all such agreements.

Clause 4—Wages and Results

Resolved, that the very apparent injustice created by the flat rate system appears to have no complete solution at this time; but it is recommended that all members of this association should do everything possible to reward the more efficient men by arranging, by transfer, to provide constant employment for these men.

Clause 5—Industrial Councils

Resolved, that in our industry we have found joint industrial councils tend only to cause dissention rather than cure it, and therefore such councils should not be continued.

Clause 6—National Joint Conference Board

Resolved, that until such time as the labor members of this board can agree to the basic principles adopted at this conference that the activities of the board shall cease.

Clause 7—Apprenticeship

Whereas, the present conditions are not favorable for the training of apprentices in the construction industry, and

Whereas, it is realized that a serious shortage of trained artizans in certain trades exist.

A Group View of the Delegates Attending the Hamilton Confe

Resolved, that the executive be authorized to take up this question with the federal department of labor in an effort to assist the employers by proper legislation and funds to alleviate this condition.

Resolved further, that the national apprenticeship system as adopted at the May, 1922, conference at Ottawa be modified where necessary by the preceding and the following recommendations, and particularly as to age limit, and that it should be used as a basis for action.

Clause 8—Costs

As a preamble to this resolution the following analysis of the present business situation should be given.

This conference realizes that the future horizon is clouded and that prophecies in these days are dangerous. It also realizes that the national prosperity cannot remain much longer in the present state of stagnation; further, that as soon as business from a national standpoint commences to move, just so soon will building work start to move.

In the construction industry there exists a scarcity of mechanics, which scarcity will be accentuated when work becomes plentiful and which condition will undoubtedly be accompanied by the usual drop in efficiency. At the same time it is realized that certain of the basic materials are at the present at an artificially low level, and for all the above reasons building costs will tend to increase. On the other hand, there still remains many centres where reasonable reductions in wages have not been put into effect, and these still remain many major materials the prices of which have not undergone proper deflation, both of which factors will, when righted, tend to decrease prices.

The conference is, therefore, of the opinion that, although the general trend of costs will be downward, the movement will be very slow and subject to temporary movements in the other direction.

* * *

FINANCES

The report of Finance Committee was as follows, in part:

The receipts will have to be greatly increased if the work that the association is doing is to be carried on efficiently, and all the field that could and should be covered in order that an association of this kind can develop its true and proper value.

In the opinion of this committee, the present conference should be followed immediately by the engagement of a man of the highest qualifications, for a period of three or four months, for the purpose of covering the whole field by interesting the most reputable and responsible concerns in the various cities and towns of Canada, securing their membership applications, and leaving at that centre some machinery in the hands of these reputable concerns for extending the list at their discretion.

As to the conferences themselves, it is, in our opinion, a most important matter that every local association in Canada should be represented by at least two delegates. In order that the extreme east and west delegates may not be constantly at a disadvantage, in the matter of railway and pullman expenses, this committee strongly recommends that in preparation for the next annual conference, the secretary prepare figures of the cost of bringing two authorized delegates from every local in Canada, and that this expense be averaged up and all pay into the secretary the same amount.

Another suggestion as an alternative is that, if the treasury can afford it, the expenses of at least one representative from each organization outside of the province where the conference is held, be paid.

Officers

The nominating committee's list of officers was accepted unanimously. The executive for 1922 will be as follows:

Past president—J. P. Anglin.

President—J. B. Carswell.

Vice-presidents—Jas. Mackie and John V. Gray.

Hon. treasurer—E. G. M. Cape.

Hon. secretary—John Grieve.

Executive—J. M. Pigott, E. G. Brousseau, M. F. Gibson.

Next Meeting in Quebec City

The next meeting of the association will be held in Quebec city.

In closing the proceedings, a vote of thanks was passed to the Hamilton association for their hospitality and hard work, and a presentation was made to E. B. Osborne, secretary of the Hamilton association.

Association of Canadian Building and Construction Industries

Who Was There.

GENERAL CONTRACTORS' SECTION

Anglin-Norcross Co., J. P. Anglin, Montreal; Bird & Woodall, H. J. A. Bird, Moose Jaw; A. J. Bonnett & Bros. A. J. Bonnett, Winnipeg; Blakelock Bros., J. Blakelock, T. Blakelock, Oakville; Casper Braun Co., Casper Braun, Kitchener; Canada Cement Co., Ltd., J .C. Malyer, Toronto; Canadian Engineering & Contracting Co., H. W. Brown, F. A. Magee, James J. MacKay, Hamilton; E. G. M. Cape & Co., E. G. M. Cape, Montreal; Carswell Construction Company, J. B. Carswell, J. R. Hagelin, Toronto; A. W. Cassidy & Co., Ltd., J. F. Craik, Saskatoon; G. A. Crain, Ottawa; Walter Davidson & Co., Ltd., J. A. Davidson, Toronto; W. E. Dillon & Co., W. E. Dillon, Toronto; G. A. Dingwall, Niagara Falls; S. E. Dinsmore Co., Ltd., S. E. Dinsmore, Windsor; Frid Construction Co., Ltd., H. D. Frid, Hamilton; W. G. Foley, Halifax; John V. Gray Construction Co., John V. Gray, R. J. Fuller, Toronto; Thomas Grace, Thomas Grace, F. S. Milligan, Sarnia; A. E. Hamilton, Moose Jaw; W. T. Harris & Son, Ltd., J. C. Harris, Halifax; H. Hayman, London; W. J. Hickey Contracting Co., W. J. Hickey, Welland; Wm. Hodgins, Niagara Falls; Hyatt Bros., Geo. Hyatt, London; Industrial Planning Co., C. D. Kilham, Stephen E. Preble, Toronto; A. E. Jupp, A. E. Jupp, A. Taylor, Toronto; Jackson Lewis Co., Ltd., C. Blake Jackson, Toronto; Kennedy Connor Co., Kennedy Connor, Hamilton, R. J. Lecky, Toronto, Lockwood & Clemens, Wm. Lockwood, Niagara Falls. Ross-Meagher Co., Jos. F Meagher, Ottawa, McDonald Construction Co., A. A. McDonald, Halifax; Norman McLeod, Ltd., Norman McLeod, Toronto; Modern Home Builders, Geo Craik, Windsor and London; Norris E. Gibb, Sarnia; Thos. Painter & Son, W. H. Painter, Toronto; Pigott-Healy Construction Co., J. M. Pigott, R. B. Pigott, Hamilton; Poole Construction Co., F. Newby, Regina; John Putherbough, London; Robertson Construction & Engineering Co., A. B. Robertson, C. D. Schwab, Niagara Falls; A. G. Skoyles Co., A. G. Skoyles, Galt; Schultz Bros., Co., Ltd., A. E. Foulds, J. Albert Taylor, Chas. Robertson, Brantford; S. F. Smith, Ottawa; Stuart & Sinclair, T. H. Sinclair, J. C. Stuart, Hamilton; Arthur C. Troy, Galt; H. A. Wickett & Co., Ltd., E. Turner, H. A. Wickett, Toronto; W. E. Wood Co., Ltd., W. R. Walker, Windsor; R. G. Wilson & Son, R. G. Wilson, London; Wilson & Wilson, Ltd., Wm. Wilson, W. A. Wilson, Regina; W. H. Yates Construction Co., W. H. Yates, A. R. McPherson, Hamilton; O. W. Zimmerman, Niagara Falls.

TRADE CONTRACTORS' SECTION

J. Addy, Hamilton; E. R. Bond, Hamilton; Bremner & Penny, John F. Bremner, Hamilton; Fred T. Brooks, Hamilton; Brousseau Bros., E. G. Brousseau, Quebec; Crane, Limited, J. H. Ryding, Toronto; William J. Crawford & Co., William J. Crawford, St. John; D. A. Cummings & Co., L. J. Cummings, alifax; P. O. Dalgleish, Moose Jaw; Wm. J. Drake, Hamilton; Electric Supply Co., Ltd., George Lowe, Hamilton; Robt. Fitzsimons Co., Ltd., Robt. Fitzsimons, Hamilton; J. W. B. Ford, Hamilton; Peter Gemmell, Hamilton; Goodale & Laidlaw, Chas. Goodale, James Laidlaw, Hamilton; H. F. Henstridge, Hamilton; Hay & Co., W. A. Smith, Woodstock; Jas. Mackie Co., Ltd., Jas. Mackie, Winnipeg; J. F. Mercer, Hamilton; And. M. McKenzie, Hamilton; B. R. Miller, Galt; Mogg Plaster Co., Wm. H. Galt, Galt; J. H. Mathias & Co., J. H. Mathias, Wm. Wills, Oakville; J. Omand, Hamilton; Walter Patison, West Hamilton; John E. Riddell & Son, Ltd., John E. Riddell, Jr., Hamilton; Ritchie Cut Stone Co., Ltd., G. W. Ritchie, Hamilton; C. H. Roper, Hamilton; H. J. St. Clair Co., H. J. St. Clair, Toronto; Windsor Builders' Association, Wm. Laesser, Windsor; J. S. Webster, Galt; Winnipeg Builders' Exchange, Jos. Bourgeault, Winnipeg.

Supply Section—Geo. Anderson & Co.; Armstrong Supply Co.; Babcock & Wilcox; Bartonville Concrete Products; Barton Lumber & Supply Co.; Bird & Son, Ltd.; Bishopric Manufacturing Co.; Brick Manufacturing & Supply Co.; Brown & Boggs Co., Ltd.; Brousseau Bros.; Burlington Steel Co.; Brantford Roofing Co.; Builders' Exchange; Canada Cement Co., Ltd.; Canada Crushed Stone Corp., Ltd.; Canada Paint Co.; Canadian Metal Window Co.; Canadian Metal Window & Steel Products; Canada Surety Co.; The Canadian Engineer; Can. Libbey-Owens Sheet Glass Co.; Chick Contracting Co.; Construction; Concrete Pipe & Products, Ltd.; Consumers' Lumber Co.; Contract Record; The Contractor; Crane Company, Ltd.; Dominion Industrial Products Co.; Dominion Paint Works, Ltd.; Dennis Wire & Iron Works; J. R Eaton

& Sons, Ltd.; Fitzgerald & Kent; W. A. Freeman & Co.; Frost Steel & Wire Co., Ltd.; Fryer & Evans; Gallagher Lime & Stone Co.; W. Giny & Sons; Hamilton Sand & Gravel Co.; The Hamilton & Toronto Sewer Pipe Co., Ltd.; Higgin Mfg. Co.; Henry Hope & Sons, Ltd.; Jackville Hill Co.; St. Catharines Bldg. Supplies; Interlocking Tile Co., Ltd.; Interprovincial Brick Co.; Kent-Ockley, Ltd.; The Long Lumber Co.; London Guarantee & Accident Co.; Metal Shingle & Siding Co.; McGregor & McIntyre Co., Ltd.; Hugh C. MacLean, Ltd.; MacLean Building Reports; Mussens, Ltd.; Mackinnon Steel Co., Ltd.; The National Fireproofing Co.; J. Edward Ogden Co.; Ontario Gypsum Co.; Otis-Fensom Elevator Co.; Pannill Door Co., Ltd.; Patterson & Crossthwaite; Pedlar People, Ltd.; Phoenix Bridge Co.; Peckover's, Ltd.; Robinson & McKay; R. A. Rogers; Wm. Rutherford & Sons, Ltd.; Schultz Bros. Co., Ltd.; Seaman-Kent Co., Ltd.; Specification Data, Ltd.; Steel Co. of Canada; Super Cement Co., Ltd.; St. Catharines Bldgs. Supplies; J. & J. Taylor, Ltd.; Toronto Brick Co., Ltd.; Trussed Concrete Steel Co.; W. Utting & Son; U. S. Fidelity & Guarantee Co.; Whitlock Marlatt, Ltd.; The Hamilton Bridge Works Co.; Hamilton Mirror Plate Co..

List of Exhibitors at the Construction Show

Burlington Steel Co., Hamilton, Ont.
Interlocking Tile Co., Toronto, Ont.
Dominion Paint Works, Walkerville, Ont.
Canadian Metal Window and Steel Products Ltd., Toronto.
Toronto Brick Co., Toronto, Ont.
National Fireproofing Co., Toronto, Ont.
Bird & Son, Ltd., Hamilton, Ont.
Bartonville Concrete Products, Hamilton, Ont.
Canadian Surety Co., Toronto, Ont.
Interprovincial Brick Co., Toronto, Ont.
Cooksville Shale Brick Co., Toronto, Ont.
Pannill Door Co., Toronto, Ont.
Frost Steel & Wire Co.
A. B. Ormsby Co., Ltd., Toronto, Ont.
Canadian Libbey-Owens Co., Hamilton, Ont.
Otis Fensom Elevator Co., Toronto, Ont.
Ontario Gypsum Co., Paris, Ont.
Bishopric Mfg. Co., Ottawa, Ont.
Henry Hope & Sons of Canada, Ltd., Toronto, Ont.
Canada Paint Co., Montreal, P. Q.
W. A. Freeman Co., Hamilton, Ont.
Hamilton Sand & Gravel, Ltd., Hamilton, Ont.
Concrete Pipe & Products Co., Hamilton, Ont.
Crane Ltd., Montreal, P.Q.
Trussed Concrete Steel Co., Walkerville, Ont.
Super Cement (Canada) Ltd., Mount Dennis, Ont.
Erie Clay Products Ltd.
Hamilton Mirror Plate Co., Hamilton, Ont.
McClary Mfg., Co.
Innes, Rodgers & Co., Hamilton, Ont.
Consumers' Lumber Co.
Babcock & Wilcox Ltd.

Wooden Highway Spans

From "Public Works"

In general the use of wooden highway bridges should be entirely prohibited in cities and large towns and should be permitted only for temporary service or for very short spans and light selected traffic, or for emergency or for very remote or mountainous districts in other places.

Steel and concrete bridges can be made far stronger, more reliable and more durable; are, when well built, less subject to injury and deterioration; are likely to be better built and designed, and are less likely to fail from overload.

The use of wooden bridges is a standing temptation to every carpenter, wood butcher and construction foreman or town commissioner to be his own engineer and mechanic, to work without proper supervision, to build in ignorance or regardless of present essentials and future requirements, and is likely to be responsible for hasty construction, inadequate strength and the use of poor materials badly fabricated.

Generally these bridges are most permissible for very short spans over small brooks, for replacing culverts or over swamps or narrow valleys where they are supported on pile bents up to a maximum of 16 feet apart. In such cases they may be made of heavy timber, forming simple full length girders, used in pairs and multiples of pair laid close enough together to carry any load that can possibly be permitted to be imposed. Ordinarily the length of spans would be limited by the available length of large sawed timber to make the tension member of the truss, preferably of the king-post or queen-post type, which will usually suffice for the unspliced chords.

For longer spans no safer or more durable wooden construction has been devised than the old-fashioned Towne lattice girder, put together with wooden pins and protected by a shingle roof. Many of these have been replaced by light steel trusses that were neither as strong, as rigid, as durable or as economical as the old wooden spans.

For ordinary spans up to 20 or 30 feet, king and queen-post trusses are simple, efficient and are easily constructed from moderate size timber with single piece lengths for bottom chords and screw end rods for vertical tension members. Care should, of course be taken to have the inclined and horizontal members of the truss properly proportioned for their respective stresses, the ends should be carefully seated to full bearing, with hard wood blocks or casting to receive the nuts and washers of the vertical rods.

At panel points and sometimes at intermediate points the floor beams should be rigidly secured to the lower chords and project beyond them to receive the ends of sturdy, well-fitted inclined struts, bracing the trusses in vertical planes.

The ends of the trusses should have ample bearings, carefully adjusted on smooth horizontal stone or concrete surfaces, or on heavy timber sills, and in either case they should be well exposed to light and air and thoroughly drained.

The floor should consist of heavy hardwood planks carried on transverse floor beams or for very narrow roadways, may be supported directly on the lower chords of the trusses when the latter are especially proportioned to carry both bending and compressive strain. The floor planks and beams should never be proportioned by guess, but the sizes and spacing should be accurately determined by selection from tables of strength that are found in all engineering handbooks. The floor planks should be securely spiked in place and economy and durability may often be promoted by making the floor in two layers so that the upper course may be worn very thin before renewal without impairing the strength of the lower course whose life can thus be greatly prolonged and the cost of renewal be decreased. In this case the lower course should be laid with clearance between the boards for ventilation and drainage and the upper course may be laid diagonally, giving great additional lateral stiffness to the bridge.

It should be kept in mind that the floor is the weakest part of the bridge and must be proportioned for the heaviest possible concentration of live load at all points, and for maximum loading throughout.

Care should be taken to have the road grade descending, if possible, from both ends of the bridge to avoid excessive impact of sudden loads; the bridge should be transverse to line of the street if possible; should be well protected by substantial handrails, wheel and hub guards, and should have prominent notices regulating traffic and speed.

A clear and complete plan and elevation of the

(Continued on page 98)

Bonds for Performance of Contracts

The Operations and Obligations of a Surety Company—Factors to be Taken into Account When Writing a Bond—Contractor's Responsibility and Experience Analyzed

By W. H. HALL,
General Manager, Canadian Surety Co., Toronto

Paper read before the conference of the Association of Canadian Building and Construction Industries

The subject upon which I have been asked to speak, namely, that of Contractors' Bonds is necessarily one of interest and importance to every builder and contractor. Because of changed conditions it has become a more common practice in recent years to acquire that the contractor furnish to the obligee or proprietor a guarantee bond to insure the performance of his contract or undertaking, in accordance with the plans and specifications, and at the price tendered for. You will be more interested of course, in the practical side of this question rather than the technical and for this reason I have chosen to deal with the former aspect of our topic.

As a preface, however, let us consider what suretyship is and also the responsibilities of a surety.

Suretyship is the obligation assumed by one known as a surety or guarantee to answer for the debt or default, of another. It is older than written history, and suretyship obligations are found among the oldest records of antiquity.

As far back as human history goes we find in civilized countries that men in positions of trust, involving the handling of property belonging to others (usually in connection with court proceedings), were required to file bonds guaranteeing that they would honestly perform their duties, and these bonds were given by friends, relatives and others. This requirement was later extended to public officials, to contractors on public construction work, and in other directions. Although the friend risked his possessions, he received no compensation, and frequently had cause to regret that he became surety.

At a very early date it became apparent that such contracts must be in writing, unless the way was to be opened to permit gross frauds.

What is a Surety Bond

What is a surety bond or guarantee bond? A surety bond is a written instrument, except in cases where a recognizance in open court is required by law. It is a contract in which usually three parties are interested. The principal, which is the person, firm or corporation that enteres upon an undertaking or contract; the surety, is the individual or corporation which guarantees the undertaking or contract of the principal, and the obligee, the one who relies upon the security of the instrument for the faithful performance of the principal's undertaking or contract.

What are the responsibilities of a surety and why do individuals go on obligations of their friends? Simply as a form they say. If they believed that there was even a remote probability of being called on to pay they would not sign; they would not dare. A debt or an admitted probability of a debt of $5,000. or $10,000. to be incurred, without consideration, and unexpectedly, would involve so great a fluctuation and disturbance in the affairs of most men, as to preclude them from the risk. Motives of ordinary prudence would prevent even the best-natured friend from becoming surety. Men take those risks because they believe them to be nil. In the great majority of cases the bondsman, if called on, is not able to pay until he rearranges his affairs; most men have their means engaged in their business or invested in property; the friendly and forgotten bond is without provision, and sales or changes must be made to meet it. So incongruous and so repulsive does it seem that a man should be called on to sign a bond, without pay, which may ultimate in a large claim against him and to which he or his estate may at the time of its maturity be unable to respond, that it is a marvel that the custom should ever have obtained, and much more of a marvel that business men and courts can still be found who prefer that sort of security to the bond of a surety company. An individual bond cannot, in the very nature of the case, be as good as a corporate bond. The individual goes right on with his business and his responsibility is subject to all ordinary mutations. He does not count the bond among his liabilities; he has no income from that class of transactions, and never expects to pay anything on them. Men do not prepare for what they do not expect. On the other hand, a surety company receives an income from the issuance of its bonds sufficient to meet all the claims arising from them; it counts each bond a liability and is compelled by law to make proper provision for it; all its assets are held, not for miscellaneous business, merchandising, speculating, etc., but for the sole purpose of protecting its written obligations. There can be no comparison between the individual and corporate bond in point of safety, convenience or propriety; and we believe that the day is not far distant, if it is not already here, when it will be regarded as outre, or out of the common course, to borrow a friend's name for surety purposes, as to borrow his shoes or his clothes for business uses.

Obligating Friends

Before surety companies were organized, as I have shown, persons signed bonds as sureties for their friends gratuitously, and as a matter of friendship and courtesy, and in many cases without the thought of ever being called upon to pay the obligation. This custom, until the organization of surety companies, was more or less obligatory.

It is noted with satisfaction that corporate or company suretyship is recognized universally as important and necessary, and that one of its chief functions is to relieve the parties between whom a contract of this nature is made, of the obligations incurred as a result of calling upon friends, relatives or business acquaintances, with possible embarrassment later. The friend is relieved of a burden that no sensible reasoning can admit he should ever be called upon to carry. The principal avoids the humiliating position of being forced to seek a surety and of placing himself under obligations in consequence of which he may later on be called upon to pay dearly for the accommodation. The obligee or proprietor is more than satisfied with a bond furnished by a surety corporation whose financial condition is under the constant inspection of the Government Insurance Superintendent—something entirely lacking in the case of the personal surety, who might die or become bankrupt unknown to the obligee, or evade responsibility by transferring his property, or endeavor to compromise when called upon to meet his obligation.

There is a peculiarity in the suurety business wherein it is different from other kinds of insurance business. In every other line of insurance the companies engaged in that insurance are the only sources from which that insurance can be obtained. There is not one of you that can insure his life except with a life office, or house against fire anywhere except in a fire insurance company. None of you can procure health or accident insurance except from a company engaged in that business, but in suretyship, if any of you has to give bond, you can go to your nearest neighbor and get that bond from him if you want to, and you might get it for nothing. Any man with a house and a piece of land, or any man with a piece of land without a house can give a bond of suretyship of almost any kind whatever. So that the competition which we have is not the competition alone with other companies engaged in the surety business, but we have the competition of personal sureties all over the country.

Contract Bonds

Coming now to the matter which is of more direct importance and interest to you, namely, that of contract bonds, let us see specifically how closely related suretyship is to the class of business in which you are engaged.

If you contract to build a bridge, or to erect any kind of public structure, you must furnish a bond guaranteeing that you, or your surety in case you fail, will complete the undertaking or pay the damages.

Are you about to sign a street paving contract? The law requires a bond.

If you have contracted to furnish the government, or municipality or public institutions with supplies of any description, you will find that one of the conditions of the contract is that you must file a bond guaranteeing that you will fulfil it.

No matter what your activity in this respect may be, whether it means erecting buildings, laying sidewalks, construction roads underground or underwater work, spanning rivers, etc., the community demands that your ability, and financial strength, alone, shall not be relied upon, but back of all this must be the bond of your surety, in case you fail.

Experience has shown and proven that there is a very serious hazard to the surety in the issuance of contract bonds. Many contigencies entirely unforeseen and not calculated against by the contractor may arise in connection with contract construction work, such as:

(a) Unusual constructural problems.

(b) Physical difficulties relating to surrounding property which, if damaged in any degree, may bring serious loss if not ruin upon the contractor;

(c) Unknown or undiscovered difficulties in the work itself, particularly in underwater or underground contracts.

(d) Changes and fluctuations in prices for materials and labor, etc.

It is therefore very necessary that the underwriter of contract bonds should possess some knowledge of contracting and engineering; especially is this true in relation to the execution of bid or proposal bonds. When we pass upon an application for a contract bond, (please mark the distinction between a bid or proposal bond and a contract bond), we have before us the copy of the contract and specifications; we know the applicant's financial ability; the experience he has had in similar work; we ascertain the amount of other contracts he has on hand to see if he is trying to do too much business on his capital (a fault not uncommon among some contractors and the cause of most of their failures), but we also have for our guidance the amounts of the proposals of other bidders for the work, and are thus able to see at a glance whether the contractor has made any serious mistake in his estimate.

Then again, contractors are often required to bid on their own specifications and must guarantee certain results; here again a knowledge of engineering and contracting is essential to serve us in determining the desirability of the risk. When a loss arises on a contract bond, the surety has the right to finish the work itself, to engage someone else to do it on its behalf, or it may abandon the work entirely and let the obligee finish it and charge up the additional cost, if any, against the bond.

Various Aspects of the Case

There are many and various aspects to be taken into account when dealing with a contract bond application and among others the following may be cited,

1—We know and carefully consider the practical ability or experience of the contractor in the work which he has undertaken and proposes to perform.

2—His financial responsibility is a vital factor commensurate with the magnitude of the work which he has contracted for.

3—Whether or not he is over-trading is a serious question;—that is whether the contractor has too many contracts on hand at the ont time in proportion to his financial resources and practical ability.

4—How does his price compare with that of the other bidders. We have found as a general rule that a contractor whose bid is below 10% of the average of all the other bids for work is within the danger line and likely to make a loss rather than a profit on his work.

5—The specifications and contracts have to be carefully perused and examined to discover onerous or unfair conditions, if any, imposed on the contractor. Although the contractor is a party to the contract agreement and must execute same he rarely has any say as to its form; hence the necessity for careful examination of its terms, in order that the interest of the contractor and his Surety may not be prejudiced. No contractor should sign a written party agreement. without perusal or examination of it, simply because it is called "the contract." The services which the Surety Company can render in this regard are valuable to the contractor and are without charge by the surety to him.

6—If the contractor should default how can his surety finish the contract or the reasonable prospect of employing others to do it at a minimum of cost and probably loss.

Bid Bonds

The general practice in Canada has been to require bidders to deposit marked cheque for a certain percentage of the amount of their proposal—usually 5% as a guarantee of good faith—the cheques of the lowest and second lowest bidders usually being retained until the contract has been awarded and signed.

In some instances the municipality, or other body calling for tenders, has not only required the bidder to put up a marked cheque with his tender but also required him to name or nominate, his proposed surety, that is to say, the bidder states in his tender whom he proposes as surety for his contract bond in case he is the successful tenderer. While it is customary for a contractor to consult with his proposed surety before nominating it in this manner, it is not absolutely essential for the surety signs nothing, and is under neither moral or legal obligation to execute the contract bond.

Again, some municipalities and Boards not only require the giving of a marked cheque but also exact what is known as a "Surety's Consent". This is a separate agreement in the form of tender and calls for execution by the surety and by its terms the surety is bound to execute on behalf of the tenderer whatever contract bond may be required of him if his bid be accepted.

Due to the fact that there is sometimes quite a delay between the opening of bids for any given work and the awarding of the contract, which means that the marked cheques of at least two of the bidders, if not more, are held during this period, resulting in the tying up of the funds of the contractors, or in their having to pay interest to their banks on their marked cheque, there has been more or less agitation of late against the requiring of marked cheques and allowing the substitution of bid or proposal bond as security for tenders. This practice has obtained across the border to a very large extent, it usually being optional in the States whether a bidder shall give a marked cheque or a bid bond, such being as a definite obligation on a set sum, usually 5% of the amount of the bid, to the effect that if the proposal of the principal on the bond is accepted that he will enter into a necessary contract and give the necessary contract bond within a certain stated period. If he fails to do so the next lowest tender is accepted and the difference between the bids is charged up against the bid bond.

In the two classes last above referred to, it is to be noticed that the surety assumes a definite obligation. As a matter of fact the obligation is often a more hazardous one than the execution of contract bonds themselves, for the surety has not the advantage of the comparative bids in underwriting a bid bond which it usually possesses when giving consideration to the execution of the contract bond.

Surety Company's Obligations

Notwithstanding this, we frequently find contractors coming in at the last moment, possibly within an hour or half an hour of the time when bids are to be received, and asking that a bid bond or Surety's Consent be executed. In many cases these contractors may have been working on their bids for days if not weeks in advance, yet expect the surety company to render its decision in the matter of giving a bid bond on a few moments notice. We know the work that is to be performed, and what the contractor's price is but unless we have some familiarity with contracting we will have to depend entirely on his figures, to find perhaps, that he has made some mistake in his estimating or omitted to include the cost of some work he is obligated to do under the contract, and that we have pledged the surety company, that its principal, the contractor, will complete the work at his price, or in the event of his failure to do so, that he will pay the municipality or the obligee on the bond—whoever it may be—the difference between the amount of his estimate, and what it actually costs to complete the work.

The surety company's application form has been arranged as a result of long experience in the business and does not contain any unnecessary query, if the interest alike of the contractor and his surety is to be preserved, and full answers to the questions asked therein, will insure a quick decision upon the proposal. If the information in regard to any question is lacking particularly in connection with the initial application from a builder or contractor delay is thereby occasioned until particulars are forthcoming. Succeeding applications from the same contractor will probably not require that we obtain all the information necessary in the first instance.

It is therefore expedient, and indeed imperative since the interest of the contractor and his surety are so closely identified, that he should furnish to the surety company, without reservation, a full statement of all facts of which it requires to be informed, in the same way as he would do if making application to his bank for a loan or line of credit. The bond of the surety company is substantially a guarantee of a contractor's reputation, personal and practical, of his credit and also of his financial responsibility.

Consequently it is creditable to the contractor to be able to furnish a corporate surety bond and it should, and very often does, pave the way for preference to such contractor in his particular line of work.

Annual Meeting of Builders of Hamilton, Ont.

The Local Branch of the A. C. B. C. I. Gets Together—New Method of Financing

In view of the Fourth Annual Conference and Exhibition of the Association of Canadian Building and Construction Industries held in the Royal Connaught Hotel, Hamilton, January 17th to 20th, the Annual Meeting of the Hamilton Association held on Wednesday, January 11th, was limited to one evening business session. Many of the members were anxious to go ahead with the splendor and specialties that were staged at last year's annual meeting of the Hamilton Branch, but the majority felt that there would be plenty of scope for speeches and celebration at the big conference on January 17th.

The president in his report for the year thoroughly covered many activities which were undertaken and carried to a successful conclusion during the year. Among these it is considered that the reduction of 10% in wages and the lowering of the cost of building materials are the outstanding features. The educational talks during the year and the annual picnic were pleasant items to look back upon.

Five large committees were appointed under the following chairmen:—membership committee, Thomas Patterson; finance committee, Bert. Harper; labor committee, J. C. Stuart; business relations committee, Guy Long; entertainment committee, E. A. Wark. Under this last named committee it is expected to carry out a series of social functions during the balance of the winter months.

No action was taken in regard to trade agreements or wages for the coming year. It was considered that this matter might well be left over until after the discussion at the annual conference.

The method of financing the Hamilton Association for the year 1922 as recommended by the Committee on Finance appears to be a very sound one and is something new in Builders' Association circles. The membership is divided into three groups, namely, general contractors, trade contractors, manufacturers and supplymen. Each group has undertaken to underwrite and secure a stated sum of money. These amounts totaled will yield a revenue to meet the budget for the year. Each group will decide for itself on the assessment for its own members to meet its proportion of the revenue.

The election of officers was the last item on the agenda. The following slate was elected to the various executive positions—President, J. F. Mercer, carpenter contractor; Vice-President, J. M. Pigott, general contractor; Second Vice-President, R. K. Palmer, chief engineer, Hamilton Bridge Works; Honorary Secretary, Thos. Patterson, retail lumber dealer; Treasurer, Frank A. Magee, general contractor.

The representatives of the various sections which go to complete the executive council will be appointed before the end of the month and the new executive body will be called together for its first meeting during the first week of February.

The annual meeting ended with the resolution that every member of the local body should do his utmost to make the approaching conference a complete success.

Bituminous Foundations for Street and Road Pavements

Two Basic Foundation Designs: Rigid and Flexible Types—Bituminous Bases Depend for Success on a Good Subgrade—Contractors are Favorable to "Black Base"

By HUGH W. SKIDMORE

Chicago Paving Laboratories Chicago, Ill.

Paper read at the American Good Roads Congress last week.

The two most important elements affecting the design of pavements for both city streets and country roads are the character and intensity of the traffic to be carried. These two factors combine to determine the probable destructiveness of the most potent of all traffic forces—impact. There are other important considerations, such as bearing power of soil, temperature, drainage, quality and quantity of local materials, etc., but all of these are of secondary consideration when compared with traffic. The remarkable changes in kind, weight and speed of vehicles which have occurred in the last few years, have necessitated departures not only from some of the accepted practice formulae pertaining to various pavement types, but also from some of the previously conceded standard types of foundation and wearing surface construction.

No One Type Adequately Meets All Conditions

It is ridiculous to assume that any one type of foundation or wearing surface will prove the best under all conditions. In fact, it is oftentimes the case that more than one basic design should be used within a given length of pavement and until this fact is more generally recognized, failures will continue to be more prevalent than they should by reason of the known limitations attending any given basic design.

Two Basic Foundation Designs

Two schools of thought, as applied to pavement foundations, have been evolved. These are essentially different in their fundamental principles. One of them seeks to overcome the destructive effect of the traffic loading, which at any instant may be converted into impact of variable intensity and often equivalent to several times the dead load, by means of a rigid slab possessing strength superior to the possible force of impact; the other dissipating the blow by absorbing a very considerable portion thereof through a flexible structure, which is always in actual contact with the subgrade, thereby insuring greater uniformity of load distribution and functioning as a distributing medium or foundation and not as a deflector.

Rigid Types Discussed

Rigid types, since they must possess strength superior to the traffic forces, have undergone in rapid succession, modifications which, with few exceptions, have been of such nature as to increase the original cost of the pavement very substantially. Perhaps the most important reason underlying the necessity of these modifications is the fact that the rigid slab is not at all times in actual contact with the subgrade and, therefore, does not always function as a distributing medium, but must sustain the entire force of the loading within itself. The fact that concrete pavements warp due to temperature stresses, which has been demonstrated by certain investigations of the Illinois State Highway Department, indicates that at almost any time the rigid slab can be expected to be functioning either as an arch, with bearing at the outside edges of the slab and free from the subgrade in the central portion, or functioning as a smple cantilever beam, with the fulcrum at or near the crown, and with outside edges not in contact with the subgrade; therefore, the maximum strength of the rigid pavement slab will be demanded when it is acting as a cantilever beam. In view of the data thus far obtained, it is only logical that this idea has been introduced into the design of rigid pavements. It is well known that the internal stresses in pavements, created by changes in temperature, often times become very powerful forces and to date the rigid type of construction has failed to offer uniformly satisfactory resistance, as evidenced by cracking.

While it is true that the seriousness of such failures is often reduced by more careful attention to drainage, preparation of subgrade, etc., they are nevertheless, admittedly inherent weaknesses in this particular type. Soil conditions in certain sections of the country may be such that during a portion of the year the bearing power of the soil will be so low that it cannot be relied upon as offering any very substantial support to the pavement structure. The unstable soil condition may be of limited extent and the soil may be of such character as to admit of ready drainage so that proper attention to this feature will remove the difficulty. Again, unstable soil during a considerable portion of the year may prevail more or less generally throughout certain localities, or the soil may be of such nature that it is practically impossible to adequately drain it with even very elaborate structures. In such cases the construction of sub-foundations may prove a practical solution, while at other times it will be found that a rigid pavement structure will be the most economical. Likewise oftentimes a combination of subgrade drainage and the construction of artificial subgrade or sub-foundation overlaid by either a rigid or a flexible type of structure will prove to be the most adequate solution.

It is quite natural that Portland cement concrete and monolithic brick and block pavements, which exemplify rigid construction types, should be passing through the experimental stage in order that they can be studied with respect to their probable ultimate efficiency. Ultimate efficiency, or economy, is of supreme importance and must include not only the original cost, but to this must be added the cost of maintenance and the total spread over a term of years representing the average natural life of the pavement.

Only quite recently have we come into possession of any very definite understanding of some of the forces to which pavements are subjected and as to what limitations appertain to various types with respect to their resistance to such forces. There remains a vast amount of information still to be acquired and investigations which are now in progress will undoubtedly indicate new channels for further study. Some of these investigations now under way deal exclusively with either the rigid or flexible type, while others include both. It has recently been my privilege to observe the work of this nature which is being conducted by the Illinois State Highway Department and to note the very commendable thoroughness with which they are attacking many of the problems surrounding several designs of modern highway construction. There is no doubt but what a fund of very valuable data will result from such impartial, scientific investigations, some of which will apply to all types of pavement construction while some will apply to only such types as are actually under investigation. It is hoped that as results are published from time to time and the possibilities of further investigation concerning either flexible or rigid types are indicated, that such studies will be immediately undertaken and that this practice will continue until all of the fundamentals underlying both the rigid and flexible types shall have been determined, and it will then be possible to design pavements with a thorough understanding of the limitations and the adaptability attending the use of both.

Flexible Types Discussed

Flexible and semi-flexible pavement structures are the oldest types known, and we have only to picture the old Roman roads to realize that the soundness of such construction was thoroughly demonstrated long ago. Although modern traffic requires a wearing surface of superior quality, it is debatable whether highways as they are so often built in this country to-day will ever prove as truly economical as they would if we employed more generally the old idea of a built-up roadbed, and then laid upon this our modern traffic floor.

Flexible foundations include gravel, broken stone, water-bound macadam, bituminous macadam, and hot-mix bituminous concrete. They are usually classified as to value in a pavement structure in reverse of the order named with bituminous concrete as the highest type. It is estimated that there are 15,000,000 square yards of "Black Base" giving satisfactory service in the U. S. A.

The bituminous foundation structure although possessing considerable beam strength, functions primarily as a shock reducer, that is, it gives slightly under the blow of impact in transmitting the load to the subgrade. Therefore, the design of this type places considerable reliance in the load supporting power of the subgrade. Its use then is dependent upon a knowledge of the ability of the subgrade to support loads equal to the probable force of impact reduced by the slab strength residing in the bituminous structure; whereas the rigid type, regardless of the bearing power of the soil, must be built to sustain the entire force of impact. For this reason a much thicker rigid foundation is required under given traffic and subgrade conditions, as has been demonstrated by impact tests.

It will be readily seen that even where soils are of questionable value as a subgrade, bituminous foundations may still be employed economically, if an artificial subgrade of broken stone, gravel, boulders or even cheaper materials, is first constructed. Where old macadam or gravel roads already exist, an exexcellent artificial subgrade is offered at almost negligible cost. If widening is necessary, this can usually be accomplished as in the case of the Kingston Pike at Knoxville, Tenn., where "black base" was laid about four inches thick over the old macadam and seven inches thick at the edges of the widened pavement. If time permitted, almost innumerable examples might be cited where "black base" has proven highly economical.

In the West, where the most extensive yardage of bituminous foundation has been laid, the general practice seems to be in taking alternate bids to specify five inches total depth for "black base" pavement and seven inches for Portland cement concrete pavement of 1-2-3 mix. And the general opinion appears to be that the "black base" type is giving superior service. Almost universally bids for "black base" pavements have been less than for either portland cement concrete pavement or asphalt wearing surface on portland cement concrete base. The saving has varied from 20 to 60 cents per square yard.

Contractors' Views

The opinions of contractors are always necessary and valuable since the very nature of their business requires that they give very careful thought to cost and practical construction features. With this idea in mind I have taken advantage of every opportunity to discuss with them construction problems and costs. In order to obtain an even more representative idea of their experience and views regarding bituminous base, questionnaires were sent to well known concerns throughout the country. Both the number of replies and valuable data contained in them greatly exceeded expectations. The combined activities of the contractors who replied cover every state in the Union as well as parts of Canada, and therefore, can be safely considered as representing the general attitude.

Briefly, the experience of contractors is such that they are willing to guarantee "black base" as readily as Portland cement concrete, and with few exceptions, stated that less risk was attached to "black base". The experience of contractors generally has been decidedly lower maintenance expense, and lower first cost except in a very few instances where freight rates proved to be an extraordinary item. Assuming equal depth of foundation, the use of same aggregate materials in both types, and Portland cement concrete not to exceed 1-2-5 in richness of mixture, 90 per cent estimated a difference in initial cost of from nothing to 50 cents per square yard less for "black base", and 75 per cent estimated "black base" at from 25 to 50 cents per square yard less than Portland cement concrete. Since it is true that under similar traffic and subgrade conditions, less depth of "black base" is required, it will readily be seen that rigid foundations will usually cost substantially more than the highest type of flexible base.

One contractor said that during the past 14 years, 85 per cent of the pavements he has laid have been upon flexible foundations, including broken stone, macadam and a goodly yardage of "black base". Certainly this contractor's experience with this type of foundation has proven highly satisfactory.

The only objection raised to "black base" construction by any of the contractors was the possibility of idle equipment in the event a protracted rainy season was encountered on work where the subgrade did not drain readily. Undoubtedly such a combination of circumstances would delay almost any kind of paving construction. However, it is quite possible that it would prove more serious with bituminous work than in the case of rigid base. If it is known that such local conditions as these are at all probable, it would seem that the engineer should provide for such a contingency by specifying an alternative.

The closing paragraph of a Southern contractor's reply seems to typify the attitude indicated by all of them:—"Our opinion is that engineers will be performing a useful service in securing the adoption of specifications for black base as an alternate to the use of concrete base."

Conclusion

In summing up the advantages of bituminous concrete foundation it is thought that some of those referred to in previous discussions will bear repetition:

1. Because of greater resistance to impact, permits the use of a thinner base course than is required of the rigid types.

2. Provides uniform contact with the subgrade, thus insuring greater uniformity of load distribution, and precluding the necessity of relying upon the pavement structure to sustain the entire force of the traffic loading.

3. Provides homogeneity of mass and positive bond between wearing course and foundation when bituminous top course is employed.

4. Provides freedom from cracks, upheavals, and ruptures which are common to rigid types.

5. Insures against the presence of moisture in the foundation structure, thus prolonging the life of the pavement.

6. Does away with the long period of time required for the curing of Portland cement concrete, thus permitting the opening of completed work to traffic immediately and providing a greater rapidity of turnover to the contractor.

7. Permits the use of the same aggregate materials as are ordinarily employed in Portland cement concrete foundations, and provides decided construction economies.

8. Under given conditions costs substantially less than rigid construction.

9. Maintenance expense is less than for rigid construction.

10. May be easily repaired at minimum cost, the surface patch method being applicable except in the case of very serious defects.

Wooden Highway Spans

(Continued From Page 92)

bridge should be provided together with the record book with proper instructions, headings, and rulings for periodical inspection that should be made every three or six months by a reliable carpenter foreman, and at least once a year by an engineer. The inspection should give particular attention to the stability of the piers and abutments, the nature of the bottom and any indications of scour or danger from freshets, noting any repairs to the masonry or wing walls. Special pains should be taken to examine all of the bearings of the trusses, beams and girders and their joints and connection at all places where there is a possibility for moisture to collect or dirt and rubbish to gather. These places should be cleaned and dried and, if necessary, provided with drainage for snow and rain water.

The timber should be carefully examined for decay and large pieces should occasionally be bored with a small bit to determine whether they are sound throughout. Bolts and screw rods should be kept adjusted, but not too tight, iron and steel rods, nuts and washers should be painted, but no paint should ever be put on the timber. Defective floor planks should be replaced as soon as noted and if repairs to the trusses themselves are needed they should be made under engineering supervision.

If the passage of loads heavier than the bridge is designed for is unavoidable, heavy longitudinal planks should be provided to distribute the wheel loads over the floor, and the latter should be shored up at panel points or under the girders at short intervals if the bridge is of simple girder construction.

Prof. C. R. Young, member of the Advisory Board of Consulting Engineers for the Detroit-Windsor Bridge, addressed the Hamilton Branch of the Engineering Institute of Canada on Jan. 13th, on the engineering features of the project.

Mainly Constructional

East and West—From Coast to Coast

Personal

The Dake Engine Company, of Grand Haven, Mich., manufacturers of the well known Dake enginee, have opened a Canadian office at 45 Adelaide St., E., Toronto. Capt. Wm. J. Stitt is in charge of the new office.

In an effort to determine most favorable spots for locating pier towers for the new Detroit-Windsor International bridge, borings of the river bed were begun recently by Charles Evan Fowler, chief engineer of the project.

Ten thousand delegates, representing all Canadian provinces, every state government, and including the mayors of 4,730 cities and towns, gathered at Chicago recently at the opening session of the National Good Roads Congress.

Messre Grant, Smith and Company and Macdonell, of Vancouver, have been awarded the contract for the construction of the extension of the Temiskaming and Northern Ontario railway from Cochrane, seventy miles northward to Tin Can Portage.

The Toronto Building Trades Council decided at a recent meeting to make another attempt to have the Workmen's Compensation Act amended to provide for the payment of 100 per cent. of an injured workman's wages instead of the present 66⅔ per cent. rate.

Damage estimated at $200,000 was caused by fire which destroyed three store buildings in the downtown secion of London, Ont., recently. The buildings destroyed were occupied by R. J. Cowan, retail hardware; the Morrison Shoe Store and the Trafford Furniture Company.

The Master Painters & Decorators' Association of Toronto, at their annual meeting, decided to adopt a new scale of wages for union labor this year, the present rate of 75 cents an hour to be reduced to 65 cents an hour. The present agreements, however, the men state, do not run out until March 31.

A report from Montreal states that the construction of a new immense grain elevator, which, when completed, may be the largest in the world, is scheduled to begin in the spring on the deep water front at Maisonneuve. The new elevator will be known as No. 3, and will have a total capacity of 10,000,000 bushels.

Reports from Leaside, Ont., are to the effect that excellent progress is being made on the remodelling of the Leaside Munitions plant for the Durant Motors. The two structures have been joined together and work is being rushed on the interior. The company expects to be on a producing basis by the end of March.

A $350,000 theatre building is to be built at the corner of Robson and Hornby streets, Vancouver, according to a recent report. The structure is to have a frontage of 120 feet on Robson street and 150 feet on Hornby street, and will comprise five stories of offices over the theatre. The theatre will have a seating capacity of 2,500.

Wage questions affecting 140,000 employees of Canadian railways were settled recently as a result of a conference between union leaders and railroad officials held at Montreal. Representatives of the men agreed to accept "permanently" the twelve and a half per cent. reduction introduced by the railways last July, and which was accepted under protest at the time.

By the middle of next month the new parliament buildings at Ottawa will be completed, except for the central tower, which has still 128 feet to go before it is completed. The entire cost of the new building up to November 15 was $10,073,000, and by the time the tower is completed it is believed that the total cost will have mounted to nearly $11,000,000.

The special committee of the legislature, appointed by the government to consider the application of Ontario engineers for legislation making it compulsory for every practising engineer to hold membership in an engineering association before being allowed to practice, listened to the proponents of the bill for a whole day at the Parliament Buildings, Toronto, recently. The opponents of the bill will have their say at the next sitting of the committee.

An interesting item reaches us from Port Arthur, Ont., which states that the use of screenings from the elevators, refuse after the cleaning of grain, has become so general for heating purposes in Port Arhur and Fort William that some hundreds of thousands of dollars will be saved during the winter on coal bills. Experiments in the use of these screenings as fuel, made during the early part of the cold season have proven so successful that they are used now in many of the big buildings.

Cold weather conditions at Montreal have failed to retard construction work on the new Mount Royal Hotel. Over 500 tons of steel is already in place and no hold-ups for lack of materials, etc., are anticipated. The following contracts were let recently in connection with this structure: Elevators, Otis-Fensom Elevator Company, Limited, Montreal; iron stairways, Western Supply Company, Winnipeg; cast iron, Canadian Allis-Chalmers Company, Montreal; plumbing fixtures, Cluff Bros. Company, Toronto.

Personal

Mr. Robert Hicks has been appointed chairman of the Public Utilities Commission at Peterboro, Ont.

Mr. George A. Goodman, of Windsor, has been elected president of the Builders' & Contractors' Association of Essex County.

Dr. T. Kennard Thomson, noted consulting engineer of New York, addressed the Peterboro branch of the Engineering Institute of Canada at a recent meeting.

Ernest Clarke, Ltd., of Windsor, Ont., have purchased the interests of R. Westcott Co. Ltd. General Contractors, of that city and will carry on the business at the same address 200 Banwell Ave.

Mr. Alexander Grant, building contractor of 837 Logan Ave., Toronto, suffered painful injuries to his back when he fell a distance of 25 ft. from the second storey of a residence, upon which he was working.

Mr. J. C. Breithaupt was recently re-elected chairman of the Water Commission of Kitchener, Ont. Mr. Breithaupt has held the office of chairman of the Commission ever since its inauguration 23 years ago.

Obituary

Mr. Eugene D. Lafleur, chief engineer of the Department of Public Works at Ottawa, died recently in that city, at the age of 61 years.

Mr. Arthur E. B. Hill, B.A.Sc., died a few days ago at his home at 1622 Parker St., Vancouver, B. C., at the age of 76 years. Deceased was born in Hillside, N.S., and graduated from McGill University, in 1875, with the degree B.A.Sc. He played a very prominent part in the location of the C.P.R. in British Columbia, and was engaged on waterworks design at Coquitlam and New Westminster. Mr. Hill was a member of the Engineering Institute of Canada

CONSTRUCTIONAL ACTIVITY

Period of January 18 to January 24, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Almaville, Que.
Mayor Lambert will receive tenders until Feb. 6th for construction of waterworks for Town.

Campbellton, N.B.
Ratepayers passed by-laws authorizing expenditures of $50,000 and $75,000 for construction of permanent streets. R. R. Beebee, Engr.

Town will construct waterworks and sewer on Arran St. at cost of $55,000. Ratepayers passed by-law.

Town will construct sewer on Water St. at cost of $20,000. R. R. Beebee, Engr.

Essex, Ont.
Construction of pavement on Victoria St., Arthur Ave., and talbot St. N. is contemplated by Town Council.

Exeter, Ont.
Town Council plan drainage improvements. B. W. Beavers, Chrm.

Goderich, Ont.
Construction of extension to sewers is contemplated by Town Council.

Ottawa, Ont.
City Council plan construction of watermains and services on various streets at cost of $100,000. A. F. Macallum, Commr. of Works.

Construction of pavement on Renfrew Ave. is contemplated by City Council. A. F. Macallum, Commr. of Works.

City Council contemplate water meters at cost of $30,000.

Construction of asphalt pavement on Waverly St. between Metcalfe and Bank Sts. is contemplated by City Council.

City Council plan resurfacing pavement on Waverly St. between Metcalfe and Elgin Sts.

Construction of asphalt pavement on Lyon St. from Chamberlain to Powell is contemplated by City Council.

Peterboro, Ont.
Plans are being prepared for pumping station to cost $200,000 for City. R. H. Parsons. Engr.

City is connecting several short sections of sewers to present system at cost of $21,816. R. H. Parsons, Engr.

Port Rowan, Ont.
Construction of conrete highway is contemplated by Town Council.

St. Johns, Que.
Construction of concrete roads at cost of $100,000 is contemplated by City. L. W. Bourassa, Engr., City Hall.

City Council plan construction of drainage system at cost of $50,000. L. W. Bourassa, Engr., City Hall.

St. Rose du Degele, Que.
B. Michaud, Deputy Min. Dept. Pub. Highways, Prov. Govt., Quebec, will receive tenders until Feb. 9th for gravelling 13.43 miles of road.

Seaforth, Ont.
Jno. McKay, clerk McKillop Twp. Council, has plans and will receive tenders at Carnegie Library Hall, Seaforth, until Feb. 4th for construction of tile drain. Marked cheque for 10 per cent. of contract price required.

Walkerton, Ont.
Construction of new sewers is contemplated by Town Council.

West Lorne, Ont.
Ratepayers passed by-law authorizing construction of permanent pavement at cost of $5,000 on Graham St. J. S. Robertson, secy.-treas.

CONTRACTS AWARDED

Ganges, B.C.
General contract for contsruction of wharf costing $8,062.22 for Dom. Govt., Dept. Pub. Works, is awarded to The Vancouver Pile Driving & Contracting Co., Ltd., Vancouver.

Halifax, N.S.
Whalen & Cossman, 671 Robie St., have general contract for construction of sewer at cost of $29,000 for City.

Ste. Therese, Que.
General contract for gravelling 22 miles of road at cost of $32,036 for Prov. Govt.. Dept. Pub. Highways, is awarded to T. E. Rousseau Ltee, 229 St. Joseph St., Quebec, Que.

Railroads, Bridges and Wharves

Kitchener, Ont.
Kitchener Light Cmsn. will receive tenders for 220 gross tons of steel rails and 1,000 steel ties. Construction of extension will be done by day labor under supervision of Supt. V. McIntyre.

Ottawa, Ont.
Construction of bridge at cost of $375,000 on Somerset St. is contemplated by City Council. A. F. Macallum, Commr. of Works.

St. Johns, Que.
Construction of subway at cost of from $80,000 to $120,000 is contemplated by City Council and G. T. Rly. L. W. Bourassa, Engr., City Hall.

CONTRACTS AWARDED

Britannia Beach, B.C.
General contract for construction of bridge across Britannia Creek at cost of $10,000 for Britannia Mining & Smelting Co., Britannia Beach, Howe Sound, B.C., is placed with Hodgson, King & Marble, 508 London Bldg., Vancouver. Steel contract is placed with Canadian Northwest Steel Co., Ltd., Prince Edward St., Vancouver.

Port Washington, B.C.
General contract for construction of wharf on North Pender Island for Dom. Govt., Dept. Pub. Works, is placed with The Vancouver Pile Driving & Contracting Co., Ltd., Vancouver.

Prince Rupert, B.C.
General contract for construction of ferry at cost of $75,000 for Prov. Govt. is awarded to Prince Rupert Drydock Co., Ltd.. Prince Rupert.

Toronto, Ont.
General contract for construction of fire walls in Lansdowne Ave. car barns at cost of $25,000 for Toronto Transportation Cmsn., Ryrie Bldg., is awarded to Bennett & Lovejoy, 95 Dowling Ave.

Public Buildings, Churches and Schools

Dorchester, Ont.
School Bd. contemplate erection of addition to school. Frank Boyes, J. O. Foyer, and John Brodie, trustees.

Edmonton, Alta.
Prov. Govt., Dept. of Education, will erect home for feeble minded at cost of $250,000 R. B. Blakey, architect, Parliament Bldgs., Edmonton.

Fort Garry, Man.
Municipality of Fort Garry contemplate repairs to school. J. B. Dumas, secy.-treas.

Fruitland, Ont.
Erection of school at cost $13,000 is contemplated by Bd. of Education. R. H. Dewar, secy.-treas.

Hamilton, Ont.
McPhie & Kelly, architects,, Bank of Hamilton Bldg., are preparing plans for alterations to Sunday School to cost $25,000 for Central Presbyterian Church Congregation.

Leamington, Ont.
Plans will be prepared for school to cost $12,000 for S.S. No. 2, Mersea Twp. A. Emerson, Stanley Beacom and Byron Foster, Trustees, Leamington P.O.

Lindsay, Ont.
Town Council contemplate installing central heating plant for town hall and municipal offices, fire hall and library. W. R. Alley, clerk.

L'Islet, Que.
Erection of school is contemplated by School Bd. D. Rodrigue, secy.-treas., L'Islet.

London, Ont.
Erection of Registry Office at cost of $50,000 is contemplated by City Council.

Plans will be prepared for Sunday School to cost $20,000 for Adelaide St. Baptist Church. Rev. G. A. Leichliter, Pastor, 554 King St.

Montreal, Que.
Foundations Co., 224 St. James St., have contract for excavations and foundations for police courts costing $3,000,000 for Prov. Govt., Dept. Pub. Works, and will receive tenders for 4,500 tons of concrete and 9,000 tons of crushed stone. E. Cormier, New Birks Bldg., L. A. Amos, 70

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The Passing of the Business Agent

The business agent has long been the bugbear of the contractor. It is significant, therefore, that at the recent construction conference in Hamilton, Ont., the contracting interests should unanimously adopt the resolution "that in the common interest of the public the employee and the employer, the policy of the Association of Canadian Building and Construction Industries shall be to deal directly with the actual employees rather than with business agents." The decision to carry out a policy of this nature means the virtual elimination of the business agent as a powerful influence on the drafting and consummation of labor agreements. Of course, it cannot be expected that the business agent will forthwith be caused to suddenly disappear, but at any rate his influence will be curbed by a gradual adoption of the principle laid down in the resolution that negotiations with labor should be conducted through the direct representatives of the employees and not through the paid agents of international unions, who have "soft jobs" to retain and often axes to grind.

This momentous decision was not hastily given. Indeed, four days of discussion were necessary before the report of the labor committee, of which the resolution referred to is a part, was offered for acceptance. This report, therefore, represents the best ideas and suggestions that were submitted and, as a clean-cut, fair and unbiased presentation of the labor problem in the conrstuction industry, is unsurpassed within our knowledge. Early in the discussion, it was obvious that the trend of contractors' experience was that the business agent was the impediment in the way of beneficial co-operation of employers and employees. The current opinion was that the paid organizers were buffers between the contractors and the unions, preventing the real sentiment of the workmen from finding expression. With well paying positions to retain, their only desire is to safeguard their own jobs, therein neglecting and disregarding public interests. One speaker at the conference even went so far as to state that in his opinion the membership of the American Federation was 150,000—the number of active business agents—the other 4,000,000 nominally involved in the organization being merely bystanders.

There is no doubt but that the influence of the paid labor leaders has, generally speaking, been very pernicious. It is generally believed that with the mitigation of the activities of these agents, labor will be more reasonable in their agreements and be more willing to co-operate on a basis that will be at once beneficial to employers, employees and the general public. Indeed, the public is really the most important factor to consider and it is significant that the resolution, as adopted by the contractors of Canada, places the public first as the element to be benefitted by direct dealing with the employees of construction work. It is a fact that public interest has been very little considered in labor negotiations, largely due to the activities of the paid business agent. With his elimination from the parties negotiating agreements. there will be assurance of closer co-operation and saner negotiations between employers and employees and, above all, a greater concern for the interests of the owners and investors, who, after all, are the ones who should be primarily considered in our construction activities.

A Place in the Counsels of the Nation's Business

In his presidential address at the conference of the Association of Canadian Building and Construction Industries, Mr. J. P. Anglin stressed the fact that the construction business is rapidly gaining greater public recognition and is a force, indeed, that is becoming influential and dominant. By coincidence, the same thought was suggested in the address of W. O. Winston, president of the Associated General Contractors of America, at the convention of that organization, held during the same week as the Hamilton conference. "For the first time," said Mr. Winston, "it can be said that the construction industry has a place in the sun, a place on the map and a place in the counsels of the nation's business."

A place in the counsels of the nation's business—that is the standing that has been attained by the building industry now for the first time. True, construction has always been regarded as somewhat important, but only recently has it been accorded anything like its rightful place among the industrial activities of the country. And the real reason for this growing prestige is the good work performed by such organizations as the Association of Canadian Building and Construction Industries, which have, as a fundamental reason for their existence, the elevation of the construction industry to a status comparable with the importance it should have by virtue of the volume and character of business carried on.

The attainment of public recognition is an achievement that will help the industry to a wonderful degree, for no business can continue without public

No. 78

Canada's Engineers—F. J. Whittaker

An engineer who has spent his whole career in municipal work, is Mr. F. J. Whittaker, recently appointed city engineer of Prince Rupert, B. C., to which position he transferred at the end of 1921 from South Vancouver, where he had occupied the position of municipal engineer for six years. In severing his connection with the municipality of South Vancouver, Mr. Whittaker was the recipient of many expressions of regret from his former associates, who joined in a farewell address and presentation to him.

Mr. Whittaker was born in England in 1875 and articled as a civil engineer in Bristol in 1893. He was appointed assistant engineer, Hendon Sanitary Authority, Middlesex, in 1896, continuing until 1898. In 1900 he became engineer of London and Clavering District Council, Peterborough, holding that position until 1911, when he removed to Canada.. In the years 1911 and 1912, Mr. Whittaker was assistant to Mr. G. S. Hanes, North Vancouver city engineer, his work being on sewer construction. In 1914 he became engineer in charge of sewer construction in South Vancouver and in 1915 he assumed the duties of municipal engineer of that municipality, resigning to take up his new duties at Prince Rupert.

As will be seen, Mr. Whittaker has spent the whole of his life since boyhood as a municipal engineer, and in that period has had control of some of the finest highways in England. He has had a wide and varied experience in sewerage and water-works systems and has a thorough knowledge of all branches of municipal work. For twelve years in England, Mr. Whittaker held, by government appointment, the position of health inspector in conjunction with his duties as engineer.

Mr. F. J. Whittaker

sympathy and interest and this is no less true of the construction business. We want to stand high in the public estimation; we want to stand for lofty principles, for sound policies, for skill, integrity and reponsibility. If we do, we may constantly count on that support of people in general that is so necessary in a business of the character of contracting. In the words, once more, of Mr. Winston, "We shall build most lastingly for prosperity if we put away the selfish habit of thinking in terms of iron and cement and begin thinking in terms of mankind. The old selfish doctrine of every man for himself has no place in this day of co-operation."

Technical Men in Politics

Editor, Contract Record:

The numer of technical men taking part in the government of the country is, indeed, very small. This fact is to be regretted, for, not until our engineers organize themselves and come forward in greater numbers, may they expect the share due them in the distribution of the control of the country's administration, as well as their share of influence.

The movement toward a greater participation of scientific men in practical politics is making more progress in the United States where the members of the engineers' associations are urged to interest themselves in the different political parties.

To illustrate the little interest taken in politics by our Canadian technical men, the following gives the number of engineers or land surveyors who are members of the legislatures of the nine provinces; British Columbia, 2 engineers; Alberta, 1 land surveyor (member of the cabinet); Saskatchewan, none; Manitoba, none; Ontario, 1 engineer; Quebec, 1 land surveyor; New Brunswick, none; Nova Scotia, none; Prince Edward Island, none.

It is evident that there is a lack of ambition among engineers. There should be ample room in the federal and pronincial governments for a good number of them, even cabinet ministers, for the direction of such departments as those of public works, railways, mines, colonization, highways, lands and forests would be in safe competent hands if their administration were entrusted to engineers.

The engineering profession has too long been considered of little importance, and if there is any truth in the statement coming from some quaters—that the university graduate has not the ability to handle men —the means to overcome this situation would seem quite simple. It rests in the development of the students' capabilities by broadening the university courses and especially by the organization of engineers' associations of graduates only, and which would finally merge into one central organization. A good start in that direction has already been made in most provinces of the Dominion, and it is to be hoped that the organizers of the movement for an association of engineers in Ontario will be early at work for the next session of the Legislature and will see that the Bill providing for it is successfully carried through this year.

Yours truly,
A. Langlois.

The first of the five steel bridges providing a new highway entrance into Hamilton, Ont.

Five Steel Bridges Form Highway Entrance into Hamilton

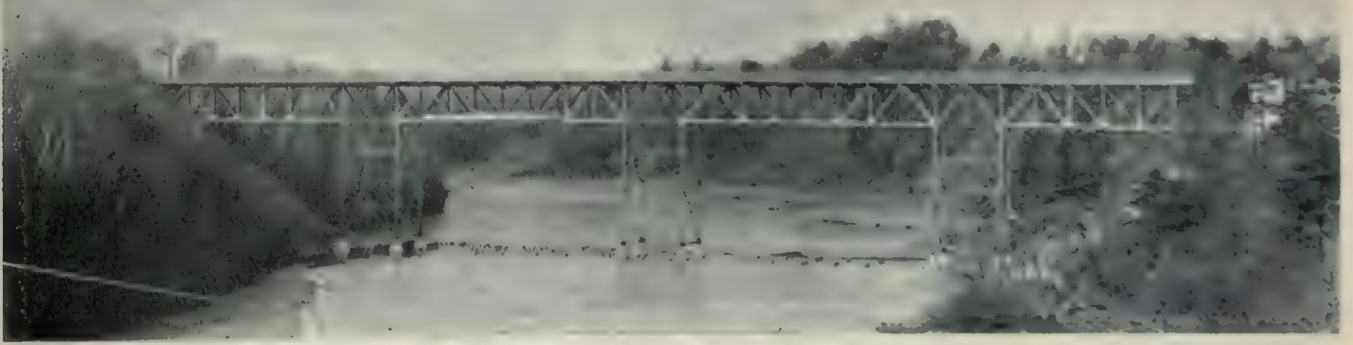
Three Structures Built by the Ontario Department of Highways and Two by the City of Hamilton Eliminate Dangerous and Circuitous Routes—This Article Gives a Complete Description of the Three Provincial Bridges, Including Details of Design and Methods of Construction

By A. B. CREALOCK, B. A. Sc.
Bridge Engineer, Ontario Department of Public Highways

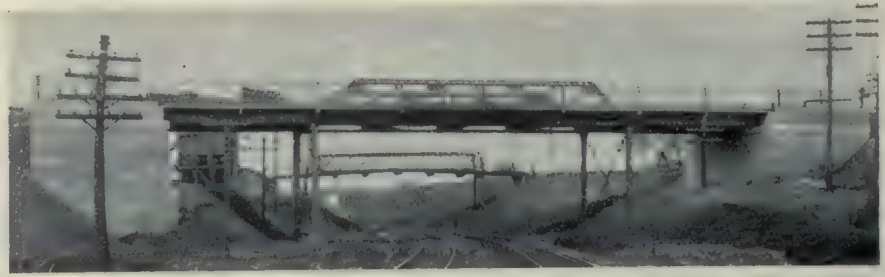
Hamilton, Ont., may justly be proud of the new high level entrance for the highways from Toronto and Guelph that is rapidly being completed by that city and the Ontario Department of Public Highways. The present entrance into Hamilton from the Toronto and Hamilton highway is very dangerous, consisting of steep grades combined with sharp turns, the whole comprising a very circuitous route to the City. In addition the roadway, while running practically parallel to the Grand Trunk Railway, is carried under the railway by a subway with very low clearance. The sharp turns and steep grade at this point make it particularly dangerous as the vision is very restricted. The roadway later on crosses over the junction cut of the Grand Trunk by an old wooden structure. Several solutions to these conditions have at various times been proposed but have been rejected as being, for the most part, prohibitive in cost. Three of these schemes are shown on the location plan. Line A. called for a bridge 3,136 feet long; line B. a bridge 1,600 feet long and line C., a bridge 1,130 feet long. None of these schemes provided for the traffic which comes down the Guelph Road. Nothing definite, however, was done until 1920 when the city of Hamilton and the Ontario Government entered into an agreement to build an entrance that would work in with the provincial highway system as well as the Toronto and Hamilton highway.

The new route as selected by the Department of Highways not only serves the Toronto and Hamilton highway but also provides an entrance for the provincial highway from Guelph and the Dundas Street provincial highway from Toronto. Dundas Street is now being improved and it is expected that in another year or two it will be carrying as much traffic as the Toronto-Hamilton highway.

The locations of the old and new routes are shown on the location plan. The new entrance, which pro-

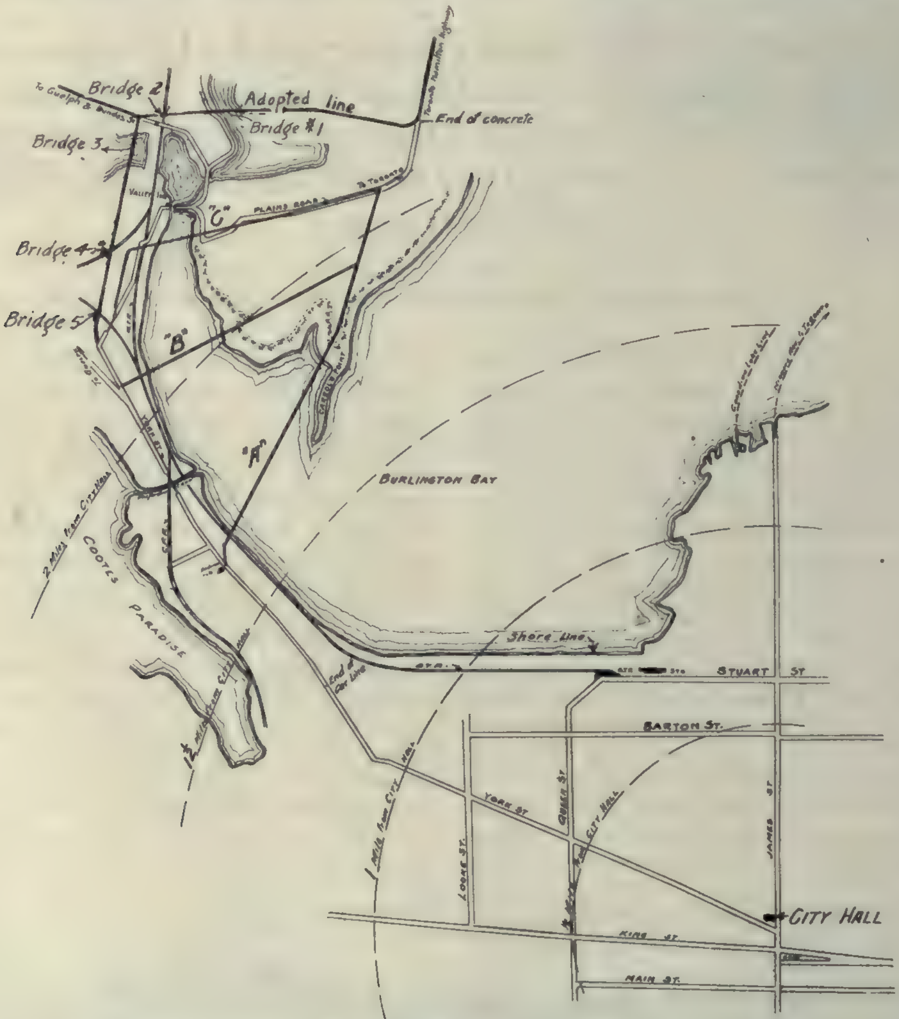


Bridge No. 3, similar to bridge No. 1, but slightly shorter



Bridge No. 2 consists of a central span of 67 feet and two 30 feet approach spans.

vides a 30-foot roadway and two 6-foot sidewalks, keeps to the high level all the way and the grades are practically level. The diversion turns off to the right from the Toronto-Hamilton highway at the present end of the concrete pavement and runs thence in a northerly direction over a deep ravine and over the main line of the Grand Trunk Railway. It then swings to the left parallel to the railway, crossing over an arm of Burlington Bay that is behind the Grand Trunk fill and then crosses over the two arms of the Junction cut of the Grand Trunk, joining the present travelled road and proceeding into Hamilton over the present high level bridge.



Alternative schemes for bringing highways into Hamilton, Ont., showing the adopted plan involving five bridges.

This new route necessitated the building of five new bridges and involved considerable grading. Bridges No's. 1, 2, and 3 are being built and the grading is being done by the Ontario Department of Public Highways. Bridges No's. 4 and 5, being within the city of Hamilton, are being built by that city.

Bridge No. 1 is the longest of the five bridges being 672 feet centre to centre of end bearings with the roadway 87 feet above the water. It was necessary to extend the west wing wall at the south end of this bridge for about 100 feet in order to hold the slope on this side.

All the pedestals for this bridge are carried on piles except pedestal No. 1 which was carried to rock, a depth of about 15 feet. The piles used in the remaining pedestals varied in length, the longest being 50 feet. The steel superstructure of this bridge weighed 1,571,000 lbs., and was erected on falsework from a traveller on the deck of the bridge. The falsework was supported on grillages for all but the third span. For this span it was necessary to drive piles.

Between bridge No. 1 and bridge No. 2 there is a fill of approximately 200 feet long and 20 feet high. The traffic is carried over the main line of the Grand Trunk by bridge No. 2, which is composed of one central span, 67 feet long, and two approach spans of 30 feet each. The Grand Trunk is in a cut at this point and the bridge spans from top of bank to top of bank. At present there is only a double track at this point but the central span was made long enough to provide for a four track line. The central span is a Warren truss extending through the sidewalk. It was necessary to use this type of construction to allow for the 22 ft. 6 in. clearance required by the Railway Board and keep the same elevation as bridge No. 1. The floor system of this span and all the steel below the level of the floor is encased in concrete to protect it from the exhaust gases from the locomotives passing below. The stringers on this span were figured as a reinforced concrete beam thus allowing a lighter stringer to be used than on the other spans.

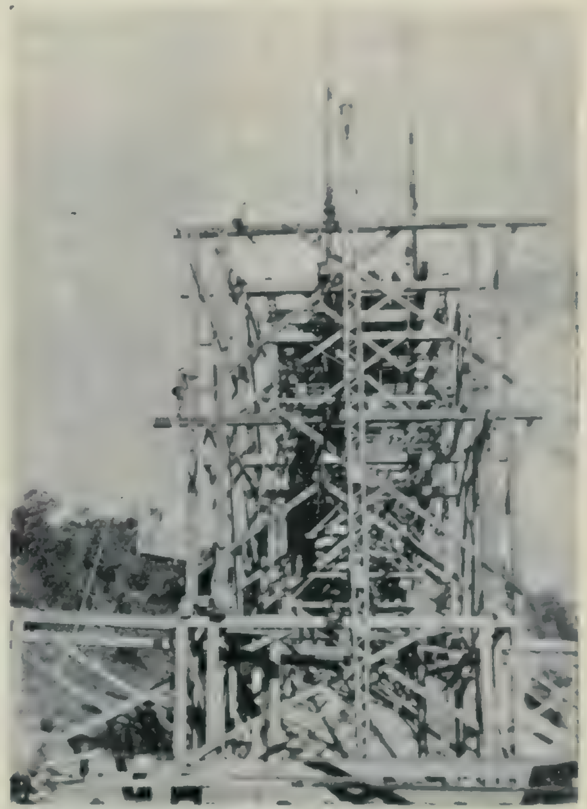
A 30 ft. roadway and two 6 ft. sidewalks give ample facilities for traffic

The 30-foot approach spans are deck plate girders of the same depth as the floor system on the central span so that the two spans, one deck type and one through type make a concentric connection on the tower leg. The steel for this bridge weighed 195,000 lbs., and was erected from the track by a derrick car.

Steel erection proceeding on wood falsework

Between bridge No. 2 and bridge No. 3 there is considerable filling to be done. It is at this point that the Guelph Road intersects and the fill is being obtained from a revision of grade on that road.

Bridge No. 3 is similar in construction to bridge No. 1, except that it is slightly shorter in length, being 596 feet centre to centre of end bearings, and the roadway is 92 feet above the water. This bridge is parallel to the Grand Trunk Railway and a fine view of it can be obtained from passing trains. The 12 pedestals supporting this bridge are all in the bay. These pedestals, as well as those of bridge No. 1, after being piled, were all cofferdammed, pumped out and the concrete poured in the dry. Supporting the centre pedestals of bridge No. 3 are piles 62 feet in length below the cut off. The piles are all single sticks, no spliced piles being used anywhere on the work. The longest of these piles were 71 feet before being cut off. The piling of these pedestals was delayed so as to take advantage of the heavy ice which usually forms here. The wait was unsuccessful as due to the extremely mild winter of 1920-1921 there was never enough ice to support the pile driver. In the spring it was necessary to drive piles to support the driver as it worked its way to the centre. These piles are all to be removed from the ice this present winter.


A progress view showing falsework and erection traveller

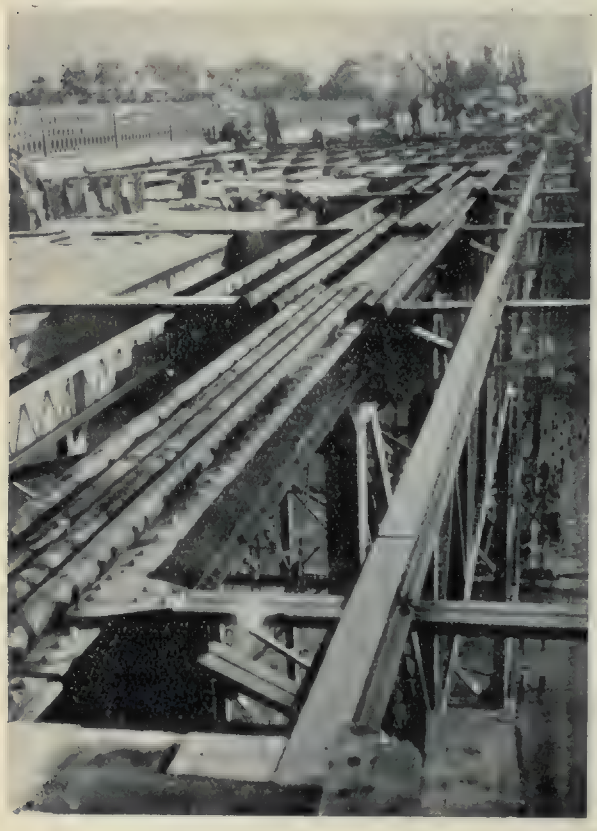
There are four anchor bolts in each pedestal. These are 1½ inch diameter rods, 3 feet 6 in. long. These were set by template as the pedestal was being poured and the concrete surrounding them is reinforced by eight ½-in. diameter rods 4 ft. long. The heads of the piles are set a distance of 2 ft. in the base of the pedestals and the concrete surrounding them is reinforced by a net-work of ⅝ in. diam. rods.

The steel superstructure for this bridge weighed 1,300,000 lbs., and was erected in a similar manner to bridge No. 1. The falsework for the two end spans sat on grillages and for the two centre spans was carried on piles.

Rolled Sections for Steelwork

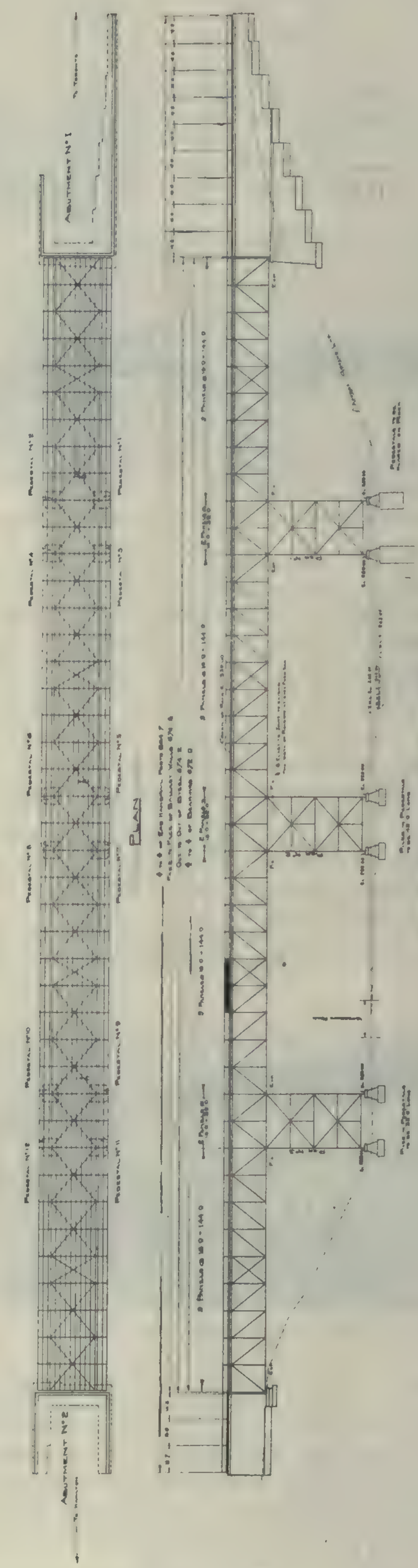
The steelwork for these three bridges, was, wherever possible, composed of rolled sections in preference to built up members. The tower legs are 14 in. H sections, the floor beams, 30 in. Bethlehem I's at 120 lbs., and the stringers 12 in. I at 31.8 lbs. The roadway floor slab is 7 in. thick at the edges and 8 in. at the centre. The centre stringers are placed 1 in. higher than the outside stringers, thus giving a total camber of 2 in. to the roadway. The slab is reinforced with expanded metal having a sectional area of 0.35 square inches per foot of width.

The sidewalk slabs are 4 in. thick and are reinforced with expanded metal. The outer edge of the concrete sidewalk is retained by a 4 in. x 3 in. x¼ in. angle rivetted to the outside sidewalk stringer. This angle does away with the building of forms on the outside of the bridge and simplifies the laying of the deck. The curbs instead of being vertical are battered on a slope of 1 in 4. This is to prevent chipping and the catching of the demountable rim nuts on automobile wheels, should they be driven close to the curb. The sidewalks are sloped ¼ in. in 1 foot to drain into the curb and the water is carried off the bridge by means of 2½ in. diameter wrought iron pipes on each side of the bridge These are placed at the centre of each panel, a distance of 16 feet apart.

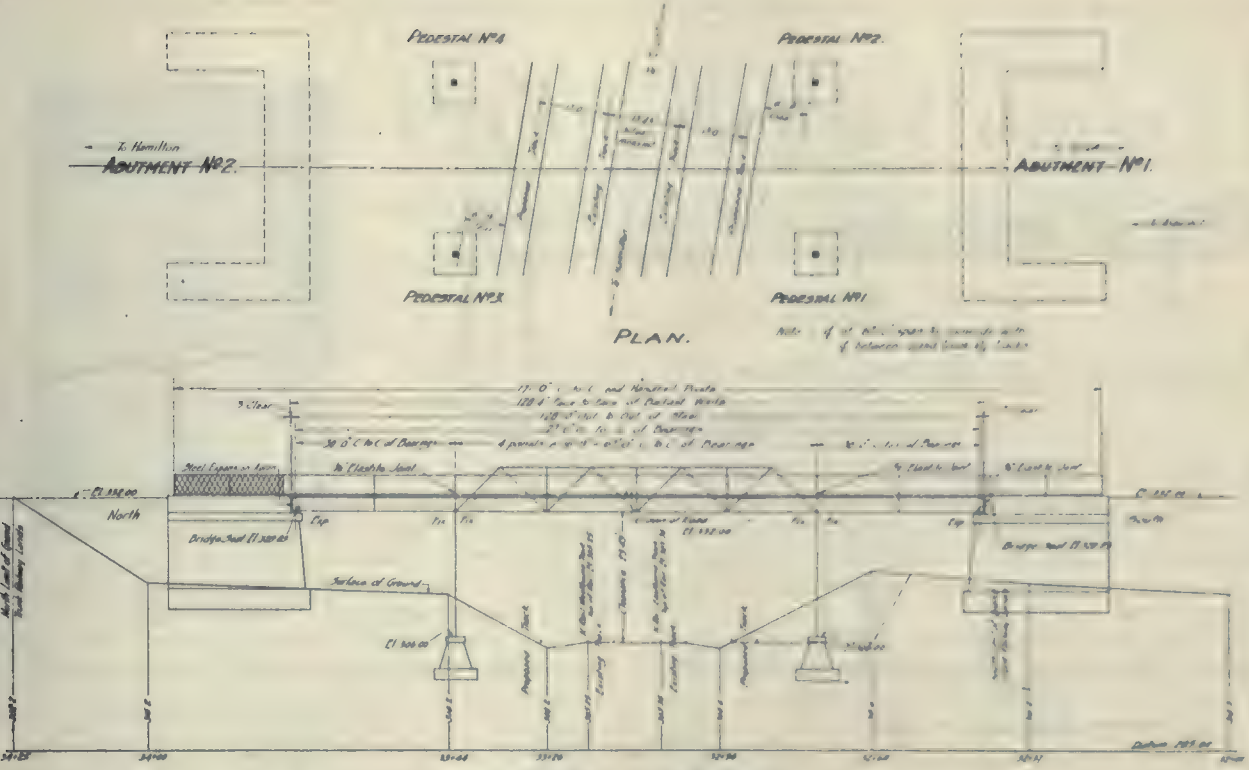


Telephone conduits are provided on the sidewalk brackets

The handrail is of a neat design and is somewhat stronger than the Department's standard handrail. The top section is composed of 2 angles 3 in. x 2 in. x 5/16-in., rivetted together to form a "T" with a 6 in. flange and a 2 in. stem. The lower section is 2½ x 2½ x 5/16-in. angle. These are laced together by bars 1½ in. x ¼ in. on the inside and angles 1½ in. x 1½ in. x ¼ in. on the outside. The lower angle of the handrail is supported at the centre of the panel by an angle rivetted to the outside stringer. The handrail posts are all 4 in. H sections at 13.5 lbs. except the end handrail posts



Plan and elevation of bridge No. 1



Plan and elevation of bridge No. 2

on abutments which are 8" H-section at 34 lbs.

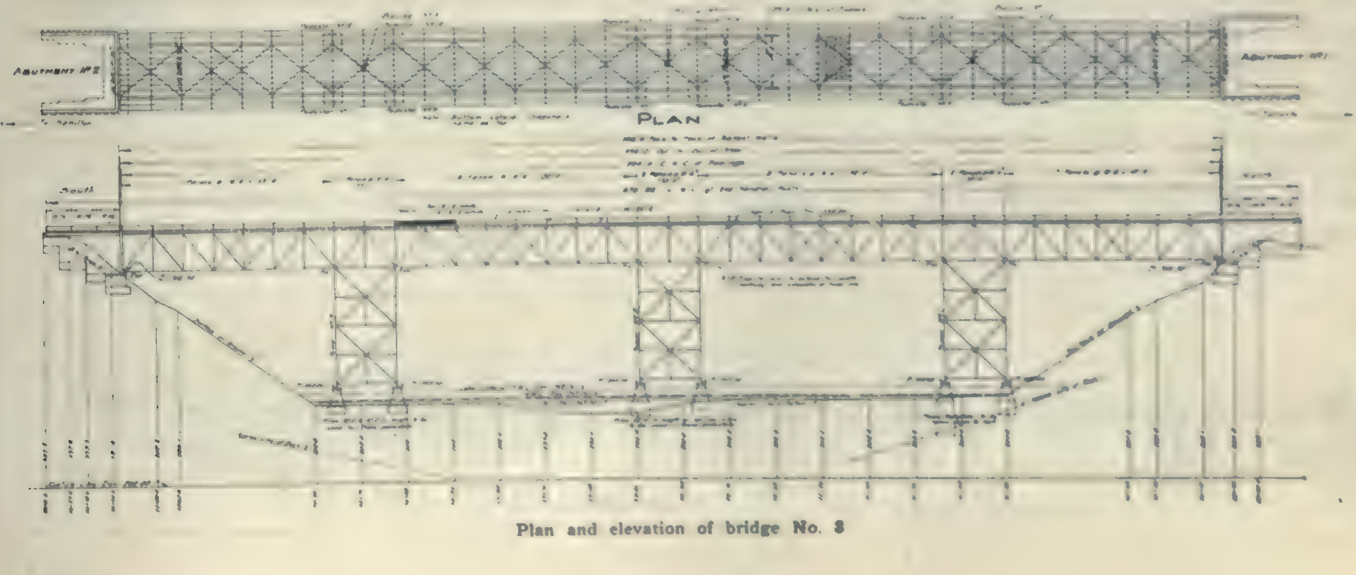
Truck for Pouring Concrete

In pouring the concrete deck of bridges No. 1 and 3 the contractor had a Ford ton truck, equipped with a dump body fitted with wheels to run on rails. The concrete was mixed at one end of the bridge and poured into the truck which was then backed out to the other end of the bridge and dumped. As the flooring was finished the rails, which were in short lengths, were lifted as the concrete reached them.

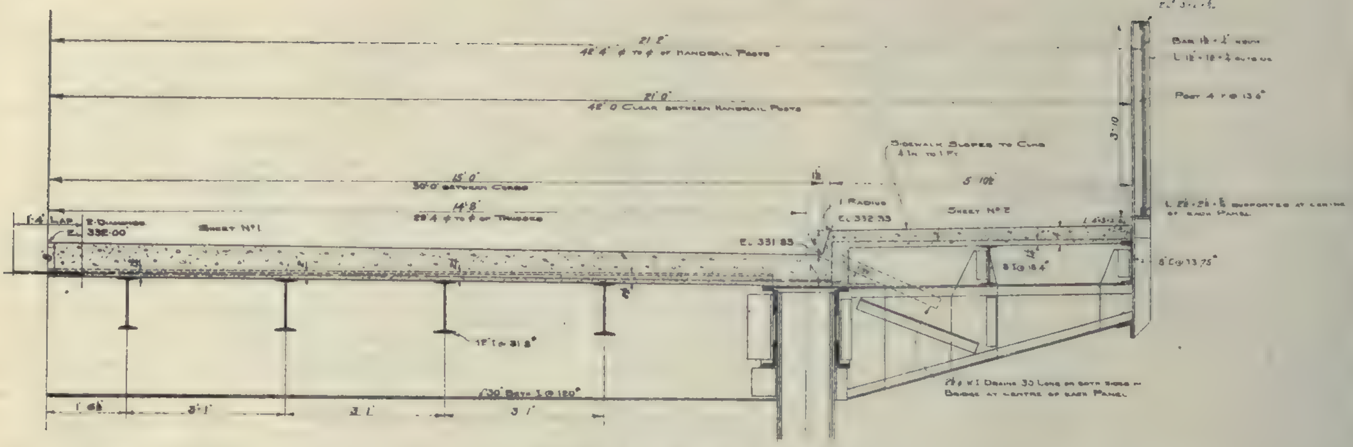
Expansion joints are provided at one end of each span of bridges No's 1 and 3 and at one end of bridge No. 2. Rollers are used on the abutments of the large bridges. All other places are provided with two sliding steel plates. Steel plates conforming to the crown of the road carry the traffic over the gaps in the concrete. These are made flush with the surface of the concrete, and the gap which is only ⅜ in. deep will fill up with dirt so that no jolt will be felt when driving over them. At the ends of the bridge these plates rest on an angle set into the concrete instead of directly on the concrete itself. A break was made in the concrete deck by a ½ in. fill of elastite over each fixed joint, to prevent the cracking of the floor.

In order to facilitate the building of these bridges the Department had a siding put in at the location of bridge No. 2. This siding is shown in the view of this bridge. The substructure contractor erected a cement storehouse and a stone-bin with an automatic unloader alongside the siding and all the material for the substructures was unloaded here. The steel for bridges 1 and 2 was also unloaded from this siding. The steel for bridge No. 3 was unloaded on a siding off the Junction cut. This siding was only about 500 feet from the Hamilton end of bridge No. 3 and the steel was hauled to the site on cars running on a narrow gauge track.

These three bridges were designed to carry class



Plan and elevation of bridge No. 3



Section of bridges Nos. 1 and 3

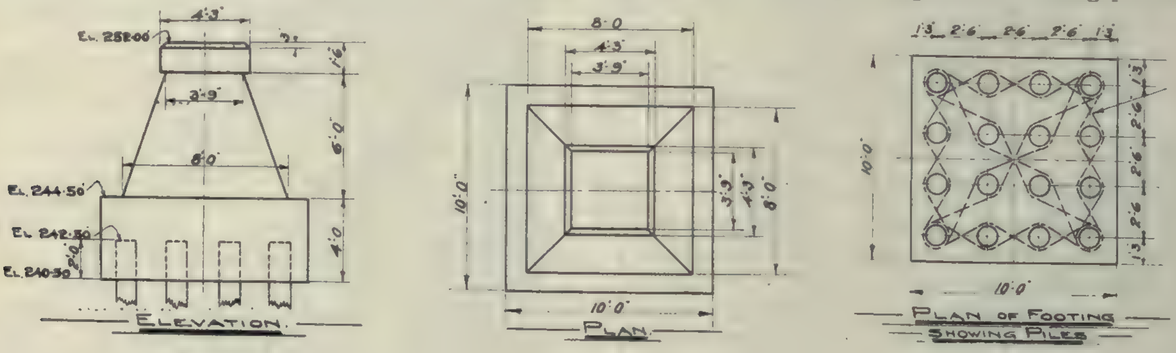
"C" loading of the highways department's specifications, which is a uniform live load of 100 lbs. per square foot over the entire roadway and sidewalk surface or a concentrated load of 20 ton roller. The bridges also carry 4 conduits on the sidewalk bracket to carry trunk telephone lines.

The original plans called for a 30 ft. road with no sidewalks. Alternative tenders, however, were called for the addition of two six foot sidewalks and it was decided to accept these tenders. These three bridges were designed and the construction carried out by the engineers of the Ontario Department of Public Highways.

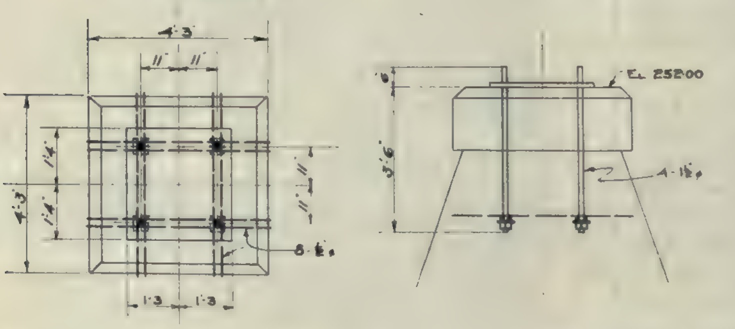
Bridges No's 4 and 5, which are being built by the city of Hamilton, cross the two arms of the Junction cut "Y" of the Grand Trunk Railway. These are deck plate girders and the steel is protected by a coating of gunite. The decks are of reinforced concrete and provide the same cross section as bridges No's 1, 2, and 3.

The work of building this entrance was started in September 1920 and at the present time bridges No's 1, 2 and 3 are completed. Bridges 4 and 5 are complete except for part of the concrete handrail and an asphalt pavement. The grading work is being proceeded with and it is expected that all work will be completed and the official opening of this new entrance will take place in the early spring.

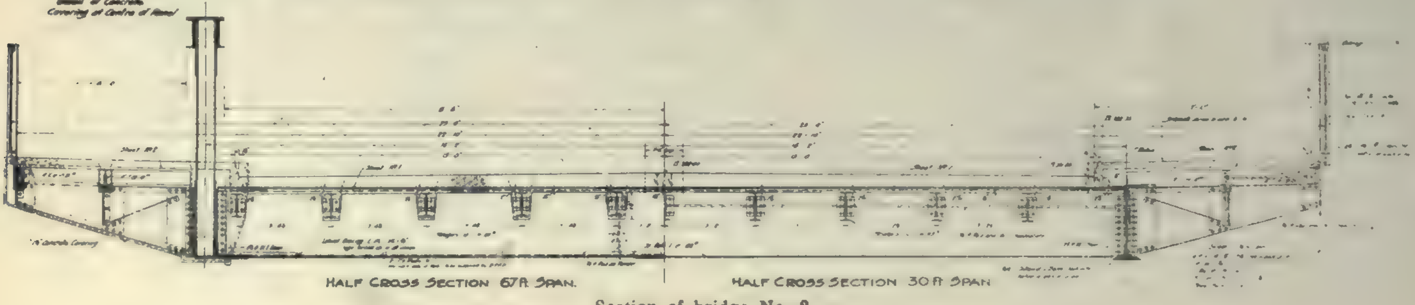
The contractors for the above work were:—Superstructure of all bridges, the Hamilton Bridge Works Co., Ltd.; substructure and decks of bridges 1, 2 and 3, F. H. Dickenson, of Toronto; the grading of provincial highway, A. Cope & Son, of Hamilton.



Above: Details of pedestals for Hamilton entrance bridges



Left: Details of anchor bolt reinforcement


Half Cross Section 67 ft. Span.
Half Cross Section 30 ft Span

Section of bridge No. 2

A. R. WHITTEMORE
Manager MacLean Building Reports, Limited, Toronto.

Prosperity is Coming

Let's Go Out and Meet It

Review of Building Industry for 1921, Giving Trend of Development and Probable Activity for 1922

By A. R. Whittemore*

The construction industry in the principal countries of the world is, with the exception of agriculture, greater than any other industry, when the yearly volume, expressed in money, is taken into consideration, and it is the greatest of all when expressed in terms of labor employment. It is computed that for the successful operation and carrying on of structural activities there are required the products of over 3,000 industries. It is estimated that this industry in Canada represents a value of $7,700,000,000 or 27 per cent of the national wealth. Fully 1,100,000 persons, either as workers or as members of workers' families, are estimated as deriving their living from this field, either directly or through manufacturing and mining products used in the construction industry.

This is a growing country; it requires in connection with that normal growth a correspondingly normal growth of building. If we go back to the year 1910 and trace the increase up to 1914, this normal increase is quite clearly defined. The line marked XY on the chart, graphically illustrates this point. This chart is developed by using the monthly averages and their increases up to the war, and theoretically continuing the increase up to the present. Since the growth of the country has continued fairly consistently year by year, such a chart cannot be said to be unreasonable or to distort the situation to any extent.

Volume Based on 1913 Costs

This chart shows a very great falling off in building of all kinds during the war—a greater falling off in actual volume of work than is indicated by the money totals of work let—because, as we know, the costs of building increased over that period quite substantially. The black line on the chart shows the value of construction contracts awarded, based on 1913 construction costs, with subsequent price inflation eliminated. These figures cover the small and rural districts as well as the large cities. In order to arrive at this curve, 1913 was taken as a normal base. In 1914 and 1915 costs dropped, and then in 1916 and 1917 the cost began to rise, as compared with the volume, until 1920, when the actual cost of construction work was 165 per cent more than what it would have cost at 1913 prices.

The dotted line on the chart shows the total value of construction contracts awarded in Canada during the past eleven years with their values placed at the current costs of the respective years.

Volume of Deferred Building in Canada

The shaded area on the chart between the estimated normal increase straight line and the black line indicating volume of quantity, gives a fair idea of the shortage of construction work in Canada and is the strongest posible way of indicating the real situation. The difference between the normal requirements of the country up to date and the buildings of all kinds provided shows a great cumulative volume of work unquestionably held back and actually required to bring the situation to normal. What we beleive to be a fair estimate of what this means to the industry (and we think that, while it may be based on more or less theoretical conditions, it is nevertheless reasonable) is that this country is short of buildings and public works at the present day, including dwellings and works of all kinds, amounting to the staggering total of one and one quarter billion dollars. If this represents the demand for building in Canada, it promises great activity in this industry, with resulting advantages to the whole country. No industry that we know of is as well fortified by a large reserve of deferred work that must be taken in hand sooner or later.

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*Address delivered at the conference of the Association of Canadian Building and Construction Industries.

At the meeting of the Associated General Contractors of America, held in Washington last September, the statement was made that building is the key to employment. It was shown that for every 200 people employed in construction 500 to 700 are set to work in basic industries, such as lumber, cement, manufacturing, mining, transportation, etc.

Review of Building in 1921

Contracts awarded for construction in Canada in 1921 fell but little short of the previous year in value. If price recessions in materials and labor costs are taken into consideration, the volume of new construction in 1921 was many millions greater than the 1920 total. The total amount for the year was $240,133,300 against $255,605,500 in 1920, $190,028,300 in 1919 and $99,842,100 in 1918. The most sweeping changes for the year took place in the increase in residential building and public works construction, and the decrease in the industrial as compared with the previous year. Residential building amounted to $76,655,400 against $54,891,100 in 1920. Business building was practically unchanged and constituted the largest group at $84,721,700 against $86,073,200. Industrial was $16,503,700 compared with $64,625,900. Public works construction was $62,252,500 against $50,015,300. During 1921 contracts were awarded for 16,283 residences, 3,224 business buildings, 241 industrial buildings and 1,136 public works.

Returns for December were $19,118,500, the second largest December total on record, being exceeded only once and that in the boom time of December 1912 with a total of $31,125,528.

For the year 1921, Ontario led all the provinces with a total of $113,855,000, Quebec next with $61,337,500; the western provinces third with $55,651,900 and the Maritimes last with $9,228,900. Both Ontario and Quebec showed moderate gains, the West a substantial falling off, and the Maritimes a severe slump.

Building in the cities found Toronto in first place with a total of $23,878,240, Montreal next with $21,381,273, York Township next with $8,101,100, Winnipeg fourth with $5,580,400, and Hamilton, Quebec, Vancouver, Ottawa, London, Halifax, Regina, Calgary and Edmonton next in the order named.

Largest Housebuilding Year on Record

1921 was the largest housebuilding year on record in Canada. However, despite this, a very real shortage still exists. Last year, for instance, 16,000 houses were built, but 110,000 couples were married. There were 117,000 immigrants who would require at least 20,000 homes. Add to this the additional thousands who are doubled up with friends or relatives, and it is easy to see why Canada requires at least 165,000 more homes.

The significance of these facts is comprehended when we realize that as soon as the wheels of industry are turning again, and the factories already built are working at normal capacity, there will be a shortage of homes far greater than Canada has ever known before. The small moderate-price dwelling is decidedly in the ascendancy.

Industrial Building Dormant

As far as industrial space is concerned, everyone knows there was a marked expansion during the war period, also during 1919 and the first part of 1920. This was the direct result of the huge European demand for goods, which was stimulated because of the curtailment in production abroad. Hence our domestic producing capacity greatly exceeds our ability to consume and export at the present time, for Europe is now taking care of her own needs to a much greater extent, and we are in a period of adjustment. It is estimated that in Canada, industrial activity is progressing only at the rate of 40 per cent. of capacity. Hence marked conservatism will continue to be exercised in the demand for industrial building mater-

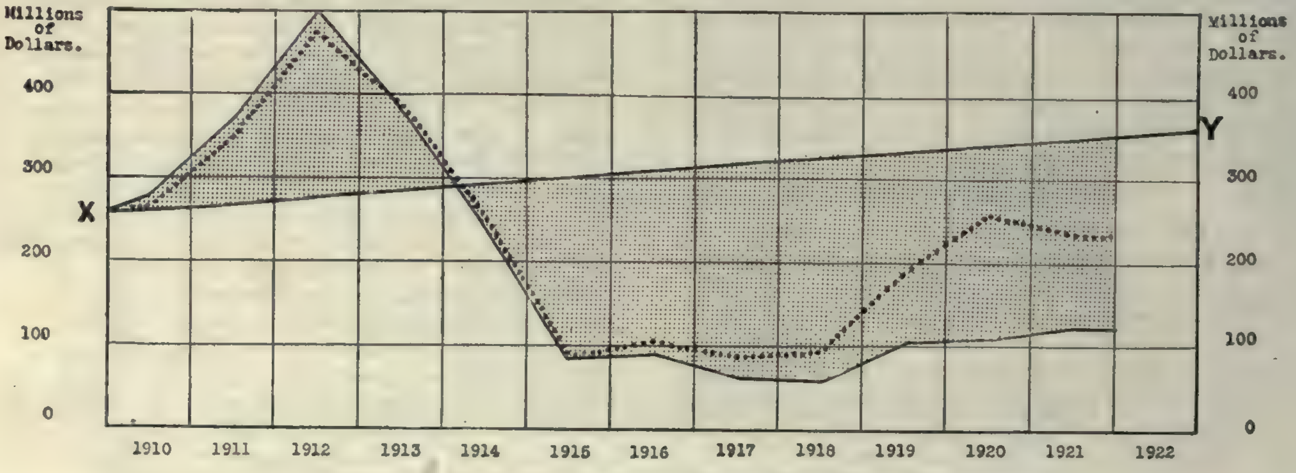


Chart Showing How Actual Construction Dropped Below Normal Requirements ials, until we are again in a period of prosperity, and until expansion is again necessary.

In 1921 the percentage of industrial prospects to the total was less than 7 per cent compared with 25 per cent in 1920, 30 per cent in 1919, and 39 per cent in 1918.

Business Building Holds Up Well

During 1921 the construction of schools, hotels, churches, offices and other business buildings was practically equal to the 1920 total, but contracts were awarded during the last six months of 1921 for 101 churches, 213 public garages, 47 hospitals, 60 hotels and clubs, 99 office buildings, 69 public buildings, 257 schools, 637 stores, 23 theatres and 125 warehouses.

The proportion of business buildings to the Dominion total of contracts awarded was 35 per cent. last year, 34 per cent. in 1920, 31 per cent. in 1919 and 26 per cent. in 1918.

Large Volume of Public Work Held Back

Public works and engineering development has been thoroughly neglected for the past several years. The need for this type of construction is very pressing, and we do not doubt that a good deal of it will materialize this year. During the last six months of 1921 contracts were awarded for 135 bridges, 50 dams and wharves, 140 sewers and watermains, 296 roadways, and 76 general engineering contracts, representing a total investment of $38,187,900. The proportion of engineering construction to the total was 26 per cent last year, 19 per cent in 1920, 14 per cent in 1919, and 20 per cent in 1918.

It is doubtful whether any business fared so well in 1921 as the construction industry as a whole, even though the volume of work has been unevenly distributed as to classes of projects and as to locality.

Building Material Costs

In May 1920 the wholesale price of 48 building materials reached a peak price of 184 per cent above 1913, whereas the average for the year was 165 per cent above the pre-war. In December, 1921, material costs had receded to a point 93 per cent above 1913, or about 50 per cent below the peak.

While prices are still much above prewar levels, the decline from the peak has been fairly radical. During the past building year they have remained relatively stable and with the prospect of general business activity increasing, the probabilities are that they will go but little below present levels until the edge is taken off demand by a year of fairly active building.

Comparative wholesale prices of building materials at Toronto show some remarkable reductions pending in January, 1922, as compared with the high prices of 1920. Here are the facts in detail.

	High 1920 Over 1914	Jan. 1922 Over 1914	Jan 1922 Less than Peak
Common Brick	20.	6.6	11.1
Structural Steel	160	30.	50.
Cement	115.3	89.7	11.9
Broken Stone	84.6	73.	6.2
Lumber	150.	63.6	34.5
Sand	66.6	55.5	6.6
Hollow Tile	80.	25.7	30.1
Lump Lime	135.7	64.3	30.3
Window Glass	167.8	5.7	60.5
Tarred Fibre	92.3	30.7	32.
Oak Flooring	166.6	44.4	48.8
Wire Nails	85.3	32.	28.7
Bath Tubs	191.1	128.3	21.3
White Lead	121.1	32.	32.
B.C. Shingles	214.2	78.5	43.1

Building activity has been greatest in those sections wherein wages have liquidated most or where some other contributing factor has made building more attractive, relatively than in other sections. We expect this movement already underway in some sections, to spread rather generally, and believe that by next spring, the level of such wages will be considerably reduced.

All told we think that 1922 should see a substantial increase in general building activity. The country has passed through the worst stages of depression, and is now on the upgrade. Indications are multiplying that general industry is advancing slowly but surely. The fact that construction activity is holding up at an unusually high level through the winter months, taken with other known factors that are likely to effect the rate of activity next year, gives promise to an unusually good year for construction in 1922.

With the progress of credit liquidation and the rise in bond prices, and the lower cost of building, mortgage money will probably be in easier supply and at lower rates, and there is a fair probability of lower freight rates in building materials. While over the longer trend it is almost certain that a year or two of active building will bring construction values downward, the present unfilled need indicates no such trend for 1922.

The present prospect is that spring will furnish an unusual opportunity for profit to the builder. Interest rates, wages, and material prices will all presumably be relatively low. Both 1922 and 1923 will probably be years of more than normal building activity, but the prospects are that the man who builds this year will stand a much better chance of making a profitable return than will the man who postpones construction work until 1923.

1921 was a year of liquidation. 1922 will be a year of recuperation. We are not in a period of "hard times coming." We are in a period of "soft times going." Prosperity is coming—it's time to go out and meet it.

Annual Meeting of Montreal Builders

Exchange Holds Record Gathering of Contractors—Work of the Past Year Reviewed—Important Activities for This Season—French Section Developing

The annual meeting of the Montreal Builders' Exchange on January 23, in the dining room of Windsor Station, was the largest attended annual gathering ever held by the Exchange, about a hundred and twenty being present. It was preceded by a supper. Mr. K. D. Church, presided.

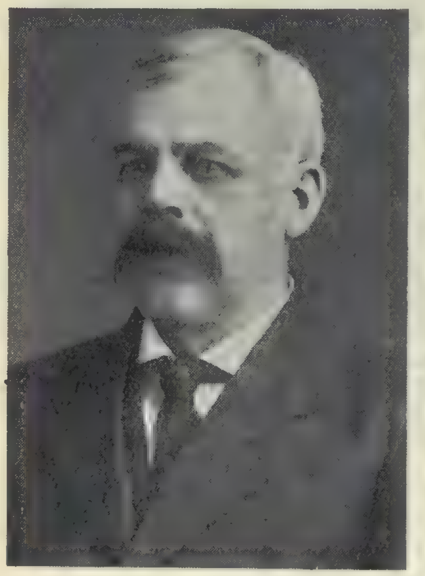
Prior to the commencement of business, Col. E. G. M. Cape outlined the proceedings of the conference of members of the Association of Canadian Building and Construction Industries held in Hamilton. Commenting on a suggestion made there as to the basic principles in a proposed new agreement between the trade-unions and employers, Col. Cape declared that if such broad, fair principles were not accepted by labor it was useless to enter into further agreements with the unions. Col. Cape further said the feeling at the conference was that new agreements with labor should be entered into very cautiously. He favored the suggestion that lists of efficient workmen should be kept by each employer and that these should be available to other firms who might later wish to employ the same men. In his view there was reason to fear a shortage of bricklayers and plasterers throughout the country, this being due to the fact that not sufficient attention had been paid to the training of apprentices. There was a general feeling at the conference that building costs would not further decline. There was a shortage of buildings throughout Canada, with a very small surplus of building materials and in view of this fact any large demand would tend to keep up the cost of materials.

Following formal business Mr. D. K. Trotter, the secretary, presented his report. This showed a small net bank balance. The secretary also reported on the work of the year, which was divided into two sections. The Exchange had dealt with many questions, including the Workmen's Compensation Acts of Ontario and Quebec, a subject which was in the hands of a committee which had not yet completed its work. Wages had been arranged in the early part of the year, and it was a matter for congratulation that while there had been strikes in many districts, the building trades of Montreal had been totally unaffected by such disputes. The board of directors had given much attention to the question of apprenticeship, and while nothing concrete has been evolved, nevertheless a considerable amount of educational work has been done. Much interest had been taken in the subject, owing to the fact that a satisfactory apprenticeship system was vital to the building trades. The board of directors had been consulted by the Referendum Committee which dealt with the better government of Montreal.

Exchange Activities

On the organization side of the work of the Exchange, attention had been given to the formation of a provincial association of the building interests. Mr. Trotter pointed out that at the present time Montreal and Quebec were the active exchanges of the province, while in Three Rivers the builders were so organized that when any matters affecting their interests came to the front, they were in a position to deal effectively

Directing the Affairs of the Montreal Builder's Exchange for 1922



Mr. K. D. Church, President

Mr. D. Bremner, 1st. vice-president

Mr. A. Gratton, 4th. vice-president

with them. In other cities and towns of the province there was no organization such as existed in Montreal, although throughout the province there were many firms prominent in the building and allied interests, and in order that these might have an opportunity of being represented when action was necessary, it had been considered advisable to form a provincial association. It was hoped thereby to give valuable support to the provincial legislature and especially to the departments of Public Works and Labor on the one hand, and to co-operate with the Association of Canadian Building and Construction Industries on the other hand when matters were brought forward in the federal government which would affect the building industries throughout the Dominion.

The Exchange had brought to a successful issue during the past few weeks the formation of a French section of the Exchange. The matter had been taken up with enthusiasm by certain prominent French firms, and the members would be asked to accept the nominations which had been put forward by the board of directors. At the last general meeting of the Exchange the by-laws were altered reducing the number of directors from nineteen to sixteen, the intention being that each section including the French section, should be equally represented on the Board. He wished to make it plain that, with the exception of past presidents, each section would be entitled to four directors for the current year.

Building Trades Exhibition

Mr. R. Keays Gustin and Lieutenant-colonel K. C. H. Monks then spoke on the subject of the proposed building trades exhibition to be held in the Dubrule Building, Montreal, from the 1st to 8th of April next. The speakers asked for the general support of the project, and also participation by members of the trade in the exhibition. It was pointed out that the purpose is to awaken the public mind to the fact that the coming months will be the right time to build, and with this object in view the following slogan had been adopted "If you are going to build, build now." Both speakers referred to the benefits which such an exhibition would give both to the building industry and to the public. It was therefore asked that the Exchange co-operate to the end of making the exhibition a success.

New Officers

The election of officers for 1922 resulted as follows:—Messrs. K. D. Church, president; Douglas Bremner, first vice-president; H. Vincent, second vice-president; A. T. Alexander, third vice-president; Alphonse Gratton, fourth vice-president; J. E. Walsh, honorary treasurer; A. Plamondon, honorary secretary. The other directors elected were: Messrs. John Quinlan, E. B. Evans, D. A. Bethune, J. W. Graham, A. W. Bremner, J. D. Johnson, T. Latourelle, and A. Leclaire.

Short speeches were made by Messrs. Douglas Bremner, H. Vincent, A. T. Alexander and Alphonse Gratton, the four vice-presidents. Mr. Bremner referred to the question of workmen's compensation, pointing out that a workman belonging to any province outside of Ontario who was injured during his work now received the same compensation from the Ontario workmen's compensation board that he would have received if he were a resident of that province. This would go far, he believed, towards the elimination of suits by injured workmen against their employers in Quebec.

The Highway Contractor's Problems

Removal of Individualism Solves Many of the Road Builder's Difficulties—Development of Public Sympathy With Contracting Activities—Methods and Equipment

By H. H. WILSON
Managing Partner, Winston & Co., New York and Richmond, Va.

Paper presented at the American Good Roads Congress, Chicago, January 16-20

Having been intimately associated with the movement toward collective organization in the highway construction industry, which has developed during the past two years, I shall attempt to interpret those things which are held, by some of the leading representatives of this industry, to be the most vital of their problems. It will only, however, be possible to very briefly touch upon each one under the several headings under which their relations may be said to function. Many problems of administration and technique will have to be omitted entirely. Bearing in mind too the present necessity and demand for lowered costs in every line of industry, I shall pay particular attention to those problems, a solution of which will, it is believed, result in decreased costs for highway building and in a dollar to the taxpayers for every dollar expended.

Internal Relationship.

The greatest problems of constructors fall under this heading and many of these problems are of their own creation. Perhaps the greatest of all relates to the education of themselves. This education should be conducted along the lines of cultivating skill, integrity and responsibility and eliminating the old time jealousy and distrust through encouragement of a spirit of co-operation and mutual helpfulness in every member of the industry. The individualistic tendency of the contractor dates from a time limited only by history and is believed to be more largely responsible than anything else for many of his existing problems.

It is good business for constructors to educate their competitors; it is good business for them to discuss each others problems, construction and administrative methods; it is good business to get each other's viewpoint, it is good business and elimnates waste both to the contractor and owner, to seek out the best means consistent with first-class work and to assist in standardization of methods and equipment along those lines; it is good business to secure added protection by all legitimate means. Organized construction can best promote these things. Sane, honest and common sense competition is better for all interested in highways than the destructive, individualistic tendency which has so often, in the past, made highway construction a financial shamble and brought upon it disrepute as a business proposition. The comparatively limited number of concerns which have been able to survive in the business with profit, over any considerable period of years, is the proof of the foregoing points.

The Public.

Mark Twain said, in substance, that it had always appeared to him that the devil had never a fair show; that, notwithstanding that certain religious sects had issued Bibles and other injurious pamphlets against him, he had never been given a chance to state his case, and there must be something to be said upon his side. Until the past two or three years, there has not been the cohesive action upon the part of constructors necessary for the presentation of their case at the bar of public opinion. The better minds of the industry recognize that our problems must be solved with the welfare of the public constantly in mind and that it will be idle to attempt that which is not economically sound. At a recent highway conference, made up of representatives from almost every line of business directly or indirectly associated with highway work, a large number of axioms were displayed. The one receiving the most comment and unanimous endorsement read:

"If I knew you and you knew me,
'Tis seldom we would disagree."

Bearing this in mind, as well as the limits outlined above, it is to the interest of the body politic that the constructor should be better known and understood and it is one of his problems to place himself in such a position.

Lower contract prices are imperatively needed to secure greater mileage of roads for the public. The greatest reduction which can be brought about would doubtless result if certain risks now assumed by the contractor were assumed by the State. It is almost superfluous to say that a constructor can figure closely on work in direct proportion as elements of risk and uncertainty are eliminated. In many places the assumption of these elements of risk and uncertainty are required by the organic law and can only be escaped by access to public opinion as expressed through legislative action. To bring about a change in these laws which will facilitate a more balanced and equitable form of contract, through the elimination of the above elements, as far as possible, and thereby permit constructors to conduct estimating and operations along well established business principles is the problem not only of the constructor but of engineers and all others interested in highway building, who desire decreased costs, and better stabilization of the industry.

It is also the problem of the highway builder to use his influence to create a public sentiment which will countenance better paid and better qualified engineers and inspectors. Constructors recognize that one of the greatest problems confronting highway commissions and chief engineers is a salary scale which will permit them to employ men more competent and experienced. It can be stated as a truism that good constructors invariably find engineers and inspectors satisfactory in direct proportion as the latter possess integrity, intelligence and experience and that the employment of high class men will invariably justify itself in an ultimate saving to the taxpayers.

As was pointed out in the recent report of the Highway Committee of the Associated General Contractors of America, the present investment in highways is held by many to be economically unsound and the elimination of all expense possible, without sacrificing quality, should benefit through better satisfaction upon the part of the public and a consequently increased volume of work for all interested.

Highway Department and Engineers.

The problem of the constructor here is to co-operate in pointing out those requirements of the specifications which entail increased costs without any commensurate advantage and those requirements which can be waived in the interests of economy without sacrificing quality. It is doubtful if there will ever be a set of specifications written for highway work which will not be susceptible of improvement, therefore, it should be the endeavor of all interested to constantly strive for improvement and economy in same. Many clauses now current suggest that the writers thought only of the equity lying on one side of their subject.

Constructors should endeavor to cultivate a broader and more sympathetic attitude, within their own ranks, as to the viewpoint and limitations of commissions, engineers and other public servants in their dealings. Many of us realize that, under present laws, the difficulty with commissions and engineers (as to many changes for which we are asking) **lies not so much in their failure to recognize the just principle to apply as in finding a means to apply it practically.**

Close acquaintance and mutual discussion, in a collective way, between contractors and engineers, will do much to bring about that better understanding and co-operation which will stimulate, and react in, added technique, a larger modicum of standardization, more economy of methods and consequent reduced costs. Organized construction is and has been moving in the direction of greater co-operation and **it is hoped that engineers and others interested will not fail to recognize the mutual advantages to be derived therefrom.** One of our problems is to bring about a realization, by all engineers and inspectors, that the constructor is their partner and not their bondman in a great work. When highway engineers, constructors material producers, equipment manufacturers and all others interested come to a complete realization of the fact that they are confederates in the most stupendous work of our age (and one by which the future will doubtless chiefly judge our civilization) highway building will be reborn and most of our problems will have been solved.

In the matter of specifications, we believe it to be one of our problems to secure the settlement, by an impartial referee (when desired by either party) of disputes between ourselves and engineers as to the interpretation of specifications and matters of equity.

Materials.

One problem here relates to the working out of a form of contract with material producers which will be a standard for the industry and more binding upon both contracting parties; in fact, it is believed that a solution of this cannot fail to reflect itself in decreased costs. The experience of many constructors with material contracts, during the war and post-war period, had a direct tendency to increase contract prices.

Another problem under this heading is the matter of responsibility for rejected material. Some producers refuse to accept responsibility for material condemned after unloading, while some engineers refuse to make final inspection until the material is unloaded. Uniformity of practice and understanding in this matter will remove an element of anxiety and loss to many constructors and will, doubtless, reflect itself in lower contract prices. Through the close co-operation of all, other inconveniences, delays and expense can be avoided.

Labor.

Uniform and fair treatment of labor and possibly more uniform wages and working conditions for the various classes of skilled labor employed upon highways are believed to be a problem from which benefit can be derived. If it were possible to develop some co-ordinated industry in the Northern and border states, whereby highway labor might be retained the year around upon some productive work, constructors would be able to secure greater economy and added efficiency from their organizations. Co-operation between concerns working in the same locality, in the matter of labor, will go far towards stabilizing conditions and creating greater efficiency.

Transportation.

Our chief problem, in this connection is to assist the railroads and indirectly the public, in the elimination of waste and expense, by so designing work and unloading facilities as to provide for prompt release of cars. During the working season, thousands of railroad cars are devoted entirely to transportation of highway materials? Much expense can be avoided and added efficiency secured for the railroads through a study of car movements and routings.

The Engineering News-Record, in a recent editorial, charged that, during the past three years of intensified paving construction, contractors had done practically nothing towards standardization of methods and equipment. Standardization of equipment holds great possibilities for efficiency and economy and organized construction is already moving in this direction. Here again the working out of standard specifications for the country at large will do much to facilitate matters as it frequently happens that equipment suitable for construction in one locality is not suitable in another.

One of our greatest problems lies in our relations with the surety companies, and it will, perhaps, be interesting to call attention to the following resolution adopted at a recent convention of highway constructors:

"Resolved that it is the sense of this meeting that a reduction in the cost of highway construction can be effected through a reduction by the surety companies of the premium now charged for contract bonds; and, it is believed this reduction will be justified by a more careful investigation upon the part of the surety companies, of contractors whom they bond."

This resolution was adopted, with a request, to a prominent surety executive present at the conference, that he present same to the surety companies' association for consideration and action. It is not going too far to allege that much demoralization has been caused in our industry (and much indirect to the taxpayers) through delayed and unsatisfactory work by the bonding of irresponsible concerns. Within the past ten years, there has been an increase of approximately 100 per cent in bond premiums and, within the past thirty years, the increase has been comparatively greater.

In conclusion, it is believed that, when the problems outlined herein have been solved, there will be fewer abandoned contracts, less loss, and trouble and expense to the public in being deprived of the use of its highways through delayed and unsatisfactory work, a saving to the taxpayers in cheaper work resulting from the elimination of improper risks in contracts, lower engineering costs through more expeditious execution of work, better work by better and better satisfied constructors, a better satisfied public and a better and cleaner highway construction industry.

Canada's Favorable Position

Canada has her troubles. They are the lesser problems of resumed growth, not of reconstruction. She has no war currency to deflate. Her budget practically balances. In foreign trade her cash position is stronger than a year ago. Her production increases. No other country in the world can point to the combination of all these factors in January, 1922.

If the course of exchange be the true augury of 1922 eventualities, the Canadian outlook is 100% better than a year ago. The new year opened with Canadian dollars at a 5% discount. The old year began business with Canadian dollars worth 85 cents apiece in New York.

In the particulars which receive first consideration when methods of actual reconstruction are authoritatively discussed, currency, budget and foreign trade, the Dominion satisfies the requirements of international credit.

But for railway investments, public revenue for two-thirds of the current fiscal year would exceed expenditure by a surplus almost again as large as the deficit of $26,000,000 disclosed. Revenue is larger than in 1920.

Originating a generation ago, the Canadian railway problem outranks all others in fundamental importance. But it has always been and remains a detail of growth, huge as it bulks today.

Actual gain in cash position of Canadian foreign trade is stronger by $150,000,000 than 12 months ago. Both exports and bank clearings have declined less than our own.

Land values have happily escaped most of the inflation which carried wheat on the ground from 70 and 80 cents a bushel to $2 and $3. Pessimism, faithfully portrayed by commercial reviews, in their New Year's greetings, has, as was human, run riot in western mercantile centers. The fundamentals, calling for more industry in compilation, have been neglected.

Grain production is of record size. At the lowest prices since 1915 the farmer receives more real value of all kinds out of those prices than wheat boards could ever bring to him. Land values at least have not to undergo the sharper wrenches of deflation.

Immigration sets in. Building revives and building costs decline. Production increases. Where is the outlook better or as good? —Barron's Financial Weekly, New York.

Associated General Contractors Meet

A Brief Review of the Conference in Cleveland---Important Construction Problems on the Agenda---General Revival Predicted by Statisticians

A definite assurance that construction recovery is under way and that it is the first phase of a general business revival sums up the results of the construction conference held in Cleveland on January 17th to 19th by the Associated General Contractors of America. Evidence of this fact, both statistical and informal, abounded in the discussion of the delegates and in the papers presented as a part of the programme.

Col. Leonard P. Ayres, who was chief statistical officer of the A. E. F., and who is now vice-president of the Cleveland Trust Co., expressed the belief that prices will continue to fall, intermittently, for ten or twenty years more, but conveyed assurance that the construction industry will be immune to many of the embarrassments of the coming period, because it supplies a market in which there is a latent demand equal to 2¼ years normal production of building. In other words, said Col. Ayres, construction can go along for nine years at 25 percent above normal and only fill the normal demand by the end of that time.

Col. Ayres said that building finance problems had commenced to adjust themselves, through greater abundance of money. The acrimonious discussions between yourselves as contractors and ourselves as bankers are about over, he remarked. Within six months so much money will be available for borrowing that owners will be able to arrange building loans on pre-war terms.

Charts shown by Col. Ayres indicated a sub-normal volume of building for every year since 1912. Even the large building figures for 1919 and 1920 were only apparent, he declared. The cost was large but the building was far behind even the current needs of the time. The only time in the last nine years, when the volume has gone above average requirements was for the last few weeks of October 1921. This was chiefly residence building, but it shows in Col. Ayres' opinion that the tide is rising rapidly. He declared that building prosperity is always the first phase of general revivals and that it disseminates prosperity more widely than any other type of activity.

Waste Elimination

Determined not merely to predict prosperity, but actually to observe it, the constructors arranged a programme in which the theme of waste elimination was constantly emphasized.

J. Park Channing, of Boston, who succeeded Herbert Hoover as chairman of the Federated Engineering Organizations, gave the major paper of the conference on this subject and said that 25 per cent. of the responsibility for waste rests on labor; 50 per cent. on management and the remaining 25 per cent on outside relationships. In respect to industrial accidents, however, he asserted that 85 per cent of the responsibility rests on the individual workman.

Constantly changing personnel is a case of waste treated by the speaker and he recommended measures to increase the period of active work so that employment will be more nearly an annual affair. He expressed faith in the method of reasoning with employees rather than ordering them, when labor emergencies are encountered. Material control was treated as a major time saving proposition in the building business.

Materials Too High

F. L. Cranford, of New York, former government director of the Muscle Shoals nitrate plant, discussed a 20,000 mile trip taken by officers of the Association in the interest of construction revival. He expressed the opinion that labor has reached pre-war efficiency and that the chief retarding factor is the general belief that material is too high, "particularly materials controlled by national associations that meet behind closed doors."

Contracts

Cost-plus contracts, fee contracts and efforts made in some projects to eliminate the general contractor were discussed. D. A. Garber, of New York, voiced the belief that few architects and engineers can qualify to direct a building project in the place of the general contractor. Godfery Edwards, of Los Angeles, decried anything but lump sum contracts, believing that when a builder takes a job on at a cost plus or a fee basis, he is paving the way for his own elimination.

The conference acted favorably on the Kenyon bill, to create a reserve fund that will stimulate construction in depressed periods. Otto T. Mallery from the department of commerce, urged that ten per cent of all public construction funds be set aside in such a reserve.

Other speakers at the convention were Ernest T. Trigg, of Philadelphia, president of the National Federation of Construction Industries, whose subject was "Co-operation in Construction," and Col. Evan Shelby, New York Attorney, who was formerly legal advisor to the construction division of the army, who spoke on "Organization in Construction,"

Obtain Public Confidence

"The opportunity before the construction industry is very great" Mr. Trigg said, "f and when the public's confidence is secured. We have passed the stage when the employers and the employees can get together with themselves and with each other and determine the affairs of their party, the public. The public has come into its power. But, until we come to where the public's confidence is restored, construction is not going to revive.

"The obligation rests with the leaders in the construction industry to clean house," Mr. Trigg emphasized. They must, he said, see that the customs of the trade which hold up costs and neutralize the effects of competition be done away with. They must also, he said, take the initative in promoting more cordial and economical relations with their workmen.

"You must not take advantage of the fact that now you have the whip hand," Mr. Trigg asserted. "By taking the broad view of things right now, you will bring about a condition of peace in industry where both you and your employees will share in ungrudged prosperity."

Col. Shelby outlined the steps by which the general contractors were organized for the first time during the war, an organization which preceded the one just closing its convention, and pointed to the accomplishments of its short existence as forecasting the progress which wiil be realized by simplifying the forms of contract, promoting research in industrial methods and improving the relations of the contractors with the material dealers and workers.

Ideals in the Contracting Business

The Address of Arthur S. Bent, President of the Associated General Contractors of America, Places the Construction Industry on a High Plane

The indutsry that we represent is not alone very great; it was the only hope of a shattered world lying almost in ruins only yesterday. Men may fight and destroy for a time, they can build forever, and the very continuity of life itself depends upon construction.

In thinking of our A. G. C. I have wondered if sometimes you thought that I was too much of an idealist. It is a profound truth that no instution can continue to exist without genuine moral worth. If that is true, then the measure of our vitality will be our moral worth. If the A. G. C. should ever stand for being served rather than serving, for having rather than being, for getting rather than giving, then it will cease to achieve any success that will be worth our time and effort.

But that has not and never has been the spirit of this organization, and please God it never will be! Victor Hugo tells us that the world lets everything die that is moved by selfishness, and the reason the A. G. C. is such a lusty young giant tonight is because it is inspired with a spirit of unselfish co-operation between ourselves, a desire to serve our public more worthily and a purpose to lift our craft to higher levels of integrity and honor.

There is a very beautiful legend, an impressive one, I think, so old that its origin is lost—I have never been able to discover it. It goes like this: Four men stood up with God when He made the world, and watched with wonder as the shimmering sphere flung from the fingers of Omnipotence found its place in the shining galaxy of stars, and one of the men said, "How was it done?" And God said to him "Go, find out for yourself." And the man went and became a scientist.

And the second man said, "What is it for?" And God said, "Go, find out for yourself." And he went and became a philospher.

"Give it to me" the third begged. And to him God said, "Go, possess it for yourself." And he went out and became the business man.

The fourth said nothing but fell down and worshipped, and God said to him "You too, shall go and because your soul burns within you, you shall create beauty." and that man went and became the artist.

Now may we not, reverently and not unfittingly, add to this noble group of God's journeymen the constructor? We who forerun and always have all the others? We who have straightened the path for their feet? We, without whom their high destinies could not be wrought out and by whom all their visions are crystallized? We work and delve for science in its onward march, and harness its magic to ways of usefulness. The bewildering and marvelous structure through which business functions is the work of our hands. Philosophy leans upon us heavily to demonstrate its theories of life, and even to art, we give its tools and make its dreams of beauty imperishable.

We are the hands through which nearly all of human thought and all of material progress are expressed. Through our highways and railways and lighting and heating and temples and schools and homes, we touch all life intimately and come very close indeed to the heart of humanity, and with that vital and varied contract comes to us an impressive but inspiring responsibility. It is given to us, if we see it rightly, to raise the standard of every man's service by the fidelity of our own.

I make no apology for such idealism in an organization like this because whatever our industry is today is the sum total of the thoughts that all the contractors in the world have about it, and it never will rise above that level. And as that level advances to higher planes of integrity and service, we shall travel further and further away from that stigma of sordidness which has clouded our history in the past, and it is given to the A. G. C. to carry that bright banner in the very vanguard.

Of course, ethical achievement is not statistical, we can't measure our progress along those lines. Nevertheless, I firmly believe, and you do too, that it will be our real, our most profitable progress, and the span of our activities is not limited to our own present interests.

We are trying to make contracting a finer thing for those who will come after us. We are consciously sewing seeds which will be harvested by those whom we can never know. Is there any finer thing in life than that?

I will just leave with you that thought, expressed again in a homely little poem called,

The Bridge Builder

An old man, travelling a lone highway,
Came at the evening cold and gray,
To a chasm deep and wide.
The old man crossed in the twilight dim,
For the sullen stream held no fears for him,
But he turned when he reached the other side
And builded a bridge to span the tide
"Old man" cried a fellow pilgrim near,
You are wasting your strength with building here
Your journey will end with the ending day
And you never again will pass this way.
You have crossed the chasm deep and wide,
Why build you a bridge at eventide?"
And the builder raised his old gray head,
"Good friend. On the path I have come" he said
There followeth after me today
A youth whose feet will pass this way.
This stream, which has been as naught to me,
To that fair-haired boy may a pitfall be.
He too, must cross in the twilight dim,
Good friend, I am building this bridge for him"

The sons of the late Mr. Anton Berg to whom reference is made elsewhere in this issue, will carry on the business inaugurated by him, manufacturing the line of brick presses that was such an outstanding development in the brick industry.

A Compressed Air Machine for Removing Pavement

Progress seems to be measured by the substitution of efficient mechanical methods for costly hand methods in every field of endeavor. You have no doubt seen several gangs of three or four men each cutting pavement with the old hand methods. One man would hold the chisel and the other two or three would strike with eight-pound hammers. This was hard work. The progress made by these gangs, if they worked continuously, was slow but they did not work continuously. To estimate that 25% of the time was lost in resting, talking and lighting pipes would be conservative. A new method for removing pavement of all kinds and for demolishing all types of masonry and concrete has been perfected, the principal feature of this new method being that the work is done rapidly by efficient compressed air operated machines instead of by slow, laborious and costly hand work.

The field of the method is almost unlimited: electric power companies may use it for tearing up the pavement for the laying of gas mains, street railway companies in the laying of new tracks or the repairing of more tracks. Wrecking companies and industrial plants use the method for demolishing various types of structures and foundations. It is also used in smelters and refineries for removing the slag in reverberatory furnaces.

Until lately all of this work was done by hand and even now much of it is being done by hand. However, a number of companies have standardized on the compressed air methods and machines. By doing this they have reduced the cost and time of this work amazingly. One case on record shows a cost saving of about 67% and a time saving of about 75%.

The paving breakers themselves are very similar in construction to the most modern non-rotating type of hand hammer rock drill. They are extremely simple and rugged and are all steel machines, principally drop forgings, so that they will stand the most severe usage encountered in their work. They are "one-man" machines.

Two paving breakers are operated by compressed air furnished from one small portable gasoline or electric driven compressor. A great deal of the success of the machines and the methods must be accredited to the great improvements incorporated in the portable compressors or more correctly speaking, compressing outfits. A portable outfit consists not only of the compressor but also of the prime mover which is either a gasolnie or an electric motor, a cooling system consisting of radiator, fan, and circulating water pump, and receiver tank all of which are mounted on a substantial steel frame which in turn is mounted on broad tread steel wheels so that the entire outfit may be quickly and easily transported from place to place.

Mechanical Methods are Cheaper

Following is a comparison of the machine versus the hand method in the tearing up of an asphalt pavement for the concrete sub-base for the laying of electric cable duct:

A very good crew of eight men using hand methods will cut about 80 linear feet of 18 in. to 24 in. width asphalt and concrete in an eight hour day. The asphalt averages 3 in. to 6 in. in thickness and the concrete about 6 in. That means 10 ft. per man per day. The cost is 50 cents per linear foot at a $5.00 wage. Three men with a compressor and two "paving breakers" cut an average of 300 linear feet per day. This costs about 16 cents per linear foot when wages, operating cost, interest, depreciation, etc., are all taken into consideration. That means a saving of two-thirds in cost—and the work is done in about one quarter of the time.

The above figures are not estimated. They were furnished by a large Eastern public service company which uses four of the above mentioned outfits. They say that each outfit pays for itself every month, and their statement is backed up by figures.

These machines have another feature which appeals to this company. It pays its men who are on this work whether it rains or shines, yet, it does not expect the men to work on rainy days. One of the officials stated that the compressor saves them $75.00 every day it rains, because, if they were using the old hand method, there would be fifteen idle men around the shops.

Speedy Work

One of the uses the Los Angeles Railway Corporation has for the "paving breakers" is the cutting of openings on either side of the rail through 6 in. of concrete, having a covering of 2 in. of asphalt. These openings are about 23 in. long and extend 17 in. on each side of the rail. Under the old hand method four men with a gad and hammers would not be able to do more than three of these openings in a day. Two men with one "paving breaker", cut twenty-two of these openings in nine hours; that means that one man using mechanical methods replaces 15 men using hand methods, and these men are paid $4.35 each. This

Compressed air appliances for removal of street pavement work is being done on a track, which is being discontinued. The openings are made in order to give gripping place under the rail for hydraulic jacks by means of which the rail is pulled out.

As an example of how the work is done, let us take the above public service company's job. The other types of work are so similar that this will suffice to cover all.

This company has four portable gasoline driven compressor outfits. Each compressor operates two "paving breakers" working continuously. The crew consists of three men (compressor man and two drill runners). The compressor man is in charge of the crew and relieves the drill men from time to time. These outfits are used for tearing up the asphalt pavement and the concrete sub-base for the purpose of laying cable ducts. They are also used for breaking out masonry for the enlarging of manholes.

In laying cable and service line ducts, stretches of pavement, 18 in. to 24 in. wide, and varying from 25 ft. to 300 ft. long (and in rarer case even longer) must be removed. The duct is laid about three feet below the street surface. This means the removal of a 3 in. to 6 in. thickness of asphalt (the asphalt is exceptionally thick), a 6 in. to 8 in. thickness of very dense concrete and, finally, about two feet of dirt.

The chisel bit is driven through the entire thickness of the asphalt at intervals of about 3 in. to 4 in. along two lines 18 in. to 24 in. apart. This is termed "marking" the asphalt. This "marking" has really the same effect as two parallel grooves. The ends also are "marked". Then the chisel is driven nearly vertically through the full thickness of the asphalt about 12 in. from one end of the job. This breaks a piece about 12 in. by 18 in. of the asphalt off from the main body. Sometimes one cut is necessary to remove a piece this size, sometimes as many as four cuts. It takes only a few seconds to make these cuts. As the asphalt is broken it is removed by hand by the relief machine operator.

Now we come to the concrete sub-base which averages about 6 in. in thickness. The moil point steel is substituted for the chisel edge steel in the "paving breaker." The moil point steel is driven through the compact sub-base. First it is driven in about the middle of the trench, that is, 9 in. from either side. This spalls off an irregular "V" shape piece, then two more cuts are made one 3 in. from each side which removes the remainder of the concrete along that line. The average is about 3 in. long for three cuts.

After the concrete has been removed, the dirt beneath it is loosened up by driving the moil point steel into it for its entire length. The dirt is then shoveled out by hand until the trench is about 3 ft. deep. Then fiber cable ducts are laid end to end and are completely bedded in concrete. Finally the trench is covered and repaved. Man-holes of various sizes and shapes are made at different points and the cable is run through the ducts from one man-hole to the other.

The above information was supplied by the Canadian Ingersoll-Rand Co., Sherbrooke, P. Q.

Mr. A. St. C. Ryley, formerly general sales manager of the Trussed Concrete Steel Co. of Canada, Ltd., Walkerville, Ont., has succeeded Mr. G. B. Reynolds as manager of the firm's Montreal office at 323 Drummond Bldg., 511 St. Catherine St. West. Mr. Reynolds has resigned to engage in other pursuits.

Anton Berg, Well Known Manufacturer of Brick Machinery, Passes Away

In the death of Anton Berg in Toronto, on January 24, the brick industry of this continent, and, indeed, of the world, lost one of its greatest benefactors, whose contributions to the science of brickmaking in the way of improved machinery have revolutionized manufacturing methods. Always keen on mechanical matters, Mr. Berg can be said to have possessed, to a remarkable degree, an inventive genius which was fortunately combined with such a fondness for hard work and patient investigation, that he always achieved remarkable success in his enterprises. In his youth, Mr. Berg received a thorough mechanical training in his native city of Christiana, Norway, where he was born in 1856. Thirty-one years later, he came to the United States and joined the International Harvester Company, as inventer, in that capacity improving and developing the machinery which that company produced. During his connection with the International Harvester Company, he began to interest himself in the brick industry and commenced the development of a brick press along quite original lines. At this stage, a prominent brick machinery company in Chicago, recognizing Mr. Berg's talents in an inventive capacity, secured his services. He thereupon perfected the brick press which the company turned out and received the diploma at the Chicago Fair for the best machine of this kind developed up to that time. Other new ideas in brick press design were latterly invented by Mr. Berg, who incorporated them in a machine which was known as the Berg Improved Press and which was manufactured by him in Anderson, Ind., and which was pronounced by the United States government to be the highest development in the art of brick making machinery. Hundreds of these presses found their way into the brick plants of the United States, speeding up and, indeed, entirely revolutionizing brick making methods.

The late Mr. Berg

Recognizing the vast opportunities in Canada for the development of the clay industries, Mr. Berg came to Toronto in 1904, spending several years thereafter in investigating the brick making facilities of the Dominion. In 1908 he established a plant in Toronto for the manufacture of the Berg presses, employing as many as 400 high grade mechanics to whom Mr. Berg was ever a friend and benefactor. He always believed in close fellowship with his men and worked constantly for their benefit.

To Mr. Berg's energy and inventive genius can be largely credited much of the development that has taken place in the brick industry of Canada in recent years. The clay products business owes him a debt of gratitude and brick makers the country over will miss his aggressiveness and sound advice, and, above all, his honesty and reliability. He was Methodist in religion, attending Broadway tabernacle, Toronto. He is survived by his wife, six daughters and four sons.

Importance of Surface Finish and Methods of Control

By H. E. BREED
Consulting Engineer, New York City

Before American Good Roads Congress

Apparently a strong mental tendency is to disregard the obvious and seek the remote. Perhaps this is because the obvious is often an aggregation of trifles, while the remote may be striking, stupendous. Certain it is that almost any more obscure cause may be heard given for the sucess or failure of any road, than the simple one of surface finish. Yet, I believe that in the concrete road economically designed, the life of the pavement depends as much upon the surface finish as upon any other factor.

We know now that impact is the great cause of destruction in our pavements. Impact is the bumping or banging of one object upon another. As I roll a smooth cylinder along a smooth table there is practically no impact but let ridges appear in the table, and as the cylinder bumps along over them, you get a series of impacts that, if the cylinder be heavy enough and rolled often enough, will soon wear out the surface and damage the structure.

That is analogous to what is happening to our roads, If the wheels of vehicles are smooth and the pavement surface is smooth there is no damaging impact from traffic. The road lives even though it be weak in proportion to the volume and weight of traffic it must carry. But let surface irregularities develop, and no matter how strongly built, the whole pavement soon shows the effect of wear. We build our roads on an average to withstand a pressure of 800 pounds per lineal inch width of tire Yet, if an unevenness in surface of only ¼ inch occurs, the impact of the one rear wheel of a five, (5), ton truck may exert an impact pressure upon the road of **20,000 pounds**. Under such pressure, the unevenness becomes a depreciation whose edges spall and break, causing further impacts and more depressions until the pavement is badly damaged.

In order to lesson impact we must get and keep smooth surfaces. How can we do it? Close scrutiny of work and infinite attention to detail are essential. Then there are certain general remedies suggested by the general cases of unevenness, specific remedies being tried by different states or on different jobs, and different methods of work and machinery.

There are five general causes of unevenness in the pavement surface:

1—Foreign materials in the aggregate, which, failing to amalgamate are ousted, leaving holes and depressions.

2—Non-uniform aggregates, which cause inequalities in wearing resistance to traffic, and subsequent depressions in the weaker places.

3—Poor workmanship in striking off and finishing.

4—Cracks, longitudinal and transverse, due to frost action, changes of temperature or unequal bearing power in the subsoil.

5—Uneven joints, perhaps the most common cause of surface trouble, due often to the piling up of joint material or to difference in elevation of slab surface.

The general remedies for surface unevenness are as obvious as the unevenness itself, and therefore, perhaps, as often neglected—strict specifications exacting good material and good workmanship. More and more we are getting these on paper. The problem is their application to the job, because there is where the human element enters. How solve the personal equation between engineer and contractor? I. wish that sometimes we might have fuller discussion on this point. The answer is at once made that the relationship should be one of co-operation and mutual endeavor toward a common end—the best possible road. But as long as private profit outdistances social welfare as an aim in our economic life, just so long are we often going to have the contractor trying to get all he can out of a job, while the engineer is trying to make him put all he can into it. So sometimes the letter of the specifications is violated, and frequently their spirit. When all engineers know their job so well that they can show contractors easier and better methods of doing their work, and when all contractors regard highway work as legitimate industry and not a financial gamble, then we shall have that adherence to specifications that will insure good work and smooth surfaces.

Three other general methods of preserving good surface finish once it is obtained are the use of steel reinforcement, the division of the road longitudinally, and the wider spacing of joints with the use of dowels.

The advantages of steel reinforcement are that it gives the road greater bearing power and greater resistance to frost action and that it offsets irregularities and weaknesses in the sub soil. By helping to preserve the integrity of the pavement, it minimizes any tendency towards cracking, which is of course a cause of surface unevenness.

The division of the road longitudinally increases its beam strength about four-fold. Observation reveals that longitudinal cracks are not found in slabs nine and ten feet wide, though we have all encountered them in slabs beyond that width. The reason for this difference is still conjectural, but until it is ascertained we would do well to be guided by results hitherto obtained, and build our concrete roads in two longitudinal sections.

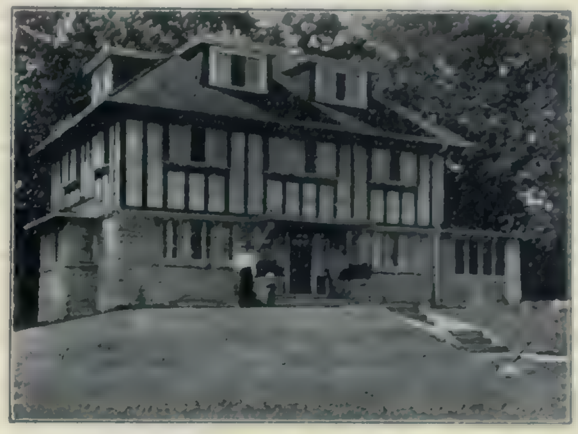
Transverse joints being a prolific source of trouble, it is well to diminish their number as far as possible through the use of the longer slab. This wider spacing of joints becomes feasible through the use of steel reinforcement to meet the temperature stresses of the slab. The use of dowels gives stability to the joints and holds the surface even. The submergence of the joints an inch below the surface has proven unsatisfactory. Devised at first to secure a smooth surface and permit the use of a finishing machine, it seemed

The Contract Record's Weekly House Suggestion

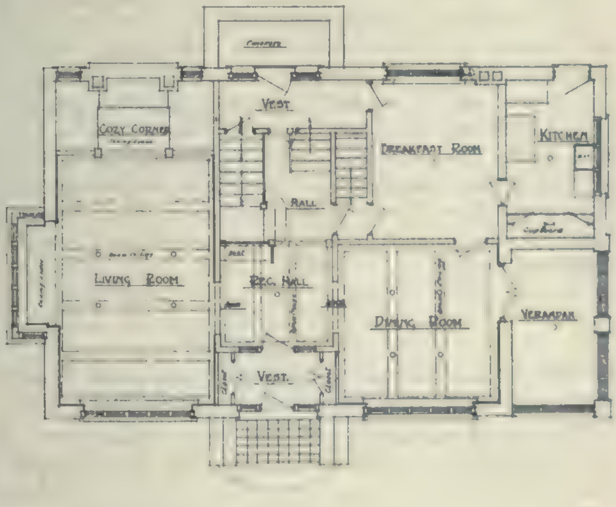
The illustration herewith shows a stone residence built on the Toronto-Hamilton highway, at Port Credit, Ont., for Mr. Thos. Blake. The main floor is divided into two sections by a through hall, one section, as seen by the plan being entirely taken up by the large living room, which contains built-in bookcases and a "cosy corner". The section to the right is subdivided into dining room, conservatory, kitchen and breakfast room. Oak is used throughout the ground floor for trim and flooring. The dining room is panelled and has a beamed ceiling, as has the living room and reception hall. There are two stairways leading to the first floor, the main and rear, both of which are of oak.

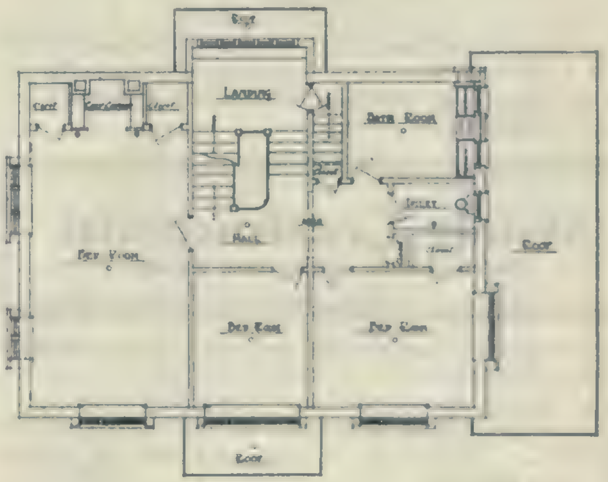
The first floor provides for four bedrooms, the large one shown on first floor plan, being directly over the living room and practically the same size. This room also has a "cosy corner" and closets on either side. The other bedrooms are also amply supplied with closets and are easily accessible from the hall. Pine flooring and trim is used throughout the bedroom flat, the trim being finished in white enamel. The bathroom and toilet are equipped with white tile walls and flooring. The attic storey contains two bedrooms, finished in pine, and occupied by the domestic help.

The hot water for heating is supplied by the boiler in the basement. The drainage is handled by a septic tank system, while water is pumped by an automatic pumping arrangement. The basement provides ample space for laundry, coal storage, fruit storage room, etc.



Stone work was done by Mr. C. O. Watters; carpentry, by Mr. C. Gallichan, both of Toronto. Mr. J. A. Thatcher, architect, 24 King St. W. Toronto, designed the house and superintended the construction.





admirable until subsequent expansion crowded and crushed the concrete above the joint material, leaving a badly ravelled and spalled joint. The best method that I have found of making a joint is to submerge the joint material until after the screed or finishing machine has passed over it; then to lift the joint material slightly above the surface with long fingered tongs; then to finish the joint with the split float or split roller, rounding the concrete next to the joint material with an edging tool.

Specific application of these general principles is found in the requirements of such states as Delaware, Pennsylvania and New York. In these states, and others, the specifications exact good workmanship by allowing a maximum of only ¼ inch depression in ten feet of pavement tested with a straight edge. The use of the straight edge on green concrete indicates depressions to be rectified and insures good results. These states specify materials with such precision as almost certainly to preclude the use of foreign materials in the aggregate or of non-uniform aggregates. They design the roads so as to minimize the danger of movement in the slab and resulting cracks. And they give special attention to the placing of joints and to the suitability of the machinery in use.

All of these precautions were taken on the road built last summer in Old Bennington, Vermont, by the Fred T. Ley Company, and so far not the slightest indication of any surface unevenness has appeared on it. This tends to support my belief that we are going to be able to build roads within necessary financial limits that under the traffic permitted by law will be practically indestructible.

The actual method of finishing is of course important in securing a smooth surface. Some road builders prefer to use the finishing machine with the roller and belt. It is essential that the roller be light. A too heavy roller pushes the crown out of the pavement, and spoils the surface. Most specifications call for a weight of from 12 to 15 pounds per foot length. Some builders omit the roller, using only the machine. My own experience indicates that the roller helps. One advantage of the finishing machine is that a dryer concrete can be used with it, which gives greater strength to the pavement. It also gives more uniform results than can be obtained with a green gang, and seems in general more fool-proof than the hand method. Still many prefer to strike off with the hand screed, using the roller and belt. This has the advantage of making one piece of plant the less to get out of order and where a heavy screed is used in the hands of competent workmen it gives as smooth a finish as the finishing machine.

With either method the board belt gives unquestionably the best finish. The bow belt however can give good results. Proper belting takes off not only the water, but also the clay loam, laitance, etc., that tend to form scale on the surface.

I have tried in this paper to bring to your attention only the salient features in securing surface smoothness in the hope that a hasty summary might help to bring practice and theory closer together so that theory might receive fresh impetus to discover the something new on the subject that I have not been able to find and tell you.

In the article descriptive of the Batiscan bridge, in the Contract Record of January 11, page 25, the author's name was erroneously spelled Painhaud, instead of Painchaud.

Mainly Constructional

East and West—From Coast to Coast

Hamilton's fire loss for the past year was the greatest on record, $717,879.

The Ontario Government it is stated is considering the building of an addition to the Royal Ontario Museum, on Bloor Street, Toronto, at an estimated cost of between $500,000 and $800,000.

The citizens of Bridgeport, Ont., through Mr. W. M. German, M. P., are making application to the Dominion Government for the enlargement of the International Bridge at this point.

The Canadian Asbestos Company, which has its head offices and many branches in Eastern Canadian cities, has announced the opening of a distribution plant in Winnipeg, to take care of the western business.

It is reported that engineers of the Department of Railways & Canals have been instructed to report on the feasibility of constructing a turning basin and docking facilities on the Welland canal at St. Catharines, Ont.

A deputation from St. Thomas, Ont., recently waited on the Elgin County Council, asking a grant of $50,000 towards the construction of the proposed Elgin Memorial Hospital. The city has subscribed $100,000 towards this project, which is estimated to cost $200,000.

The new $98,000 artificial ice arena at Galt, Ont., was officially opened recently. The ice plant will not be installed until next winter, but a natural ice surface is available for hockey this winter. The arena was designed by Mr. F. C. Bodley, of Brantford, and is one of the finest in the province.

The Britania Mining & Smelting Co., Britannia Beach, B. C., has awarded the steel contract for their large new $500,000 ore concentrator plant, to the Canadian Northwest Steel Company, of Vancouver. About 1,300 tons of steel will be required for this structure. This company also propose erecting a $10,000 bridge to replace the structure carried away in the recent flood disaster. Messrs. Hodgson, King & Marble have been awarded the contract for the construction of the bridge.

The officers elected for 1922 at the recent annual meeting of the Montreal Builders' Exchange, Inc., were as follows:- Messrs. K. D. Church, president; Douglas Bremner, first vice-president; H. Vincent, second vice-president; A. T. Alexander, third vice-president; Alphonse Gratton, fourth vice-president; J. E. Walsh, honorary treasurer; A. Plamondon, honorary secretary. The other directors elected were Messrs. John Quinlan, E. B. Evans, D. A. Bethune, J. W. Graham, A. W. Bremner, J. D. Johnson, T. Latourelle and A. LeGlaire.

A recent report states that the Provincial Home Builders' Association, Stock Exchange Building, Toronto, are planning to erect a large number of workmen's dwellings, of the $3,000 and $6,000 types, to be paid for in weekly instalments by the purchasers, with a small initial cash payment. The directorate of the above company is made up of the following gentlemen: Messrs. W. H. Alderson, Norman McEachren, S. W. Burns, P. W. Godson, C. T. Hearn, Ross Clark, J. W. Siddall, J. Martin Gardner, Charles Ring and A. W. Young.

The Manitoba Government, it is announced, will sponsor a compulsory arbitration bill at the present session of the Ligislature, making strikes and lockouts of public utility workers illegal in the province until the joint council of industry has considered and rendered a decision on any disputes which may arise. All employes as defined by the Public Utilities Act as "utility workers" would be embraced in the "no strike" proposal and would be prohibited categorically from belonging to an outside labor organization. This would embrace municipal, civil and provincial government workers.

Personal

Mr John Campbell was recently appointed engineer of the Water Works Department, at Dresden, Ont.

Messrs. Philip J. Turner and A. J. Hazelgrove, architects, have removed their offices from 241 to 284 Beaver Hall Hill, Montreal.

Mr. A. E. Doucet, Director of Public Works, Montreal, has tendered his resignation to the city, to take effect today. Mr. Doucet was responsible for many public service improvements during his term of office and much credit is due him for the installation of Montreal's present excellent water works system.

Mr. J. G. Sullivan, Consulting engineer, of Winnipeg and former chief engineer for the Canadian Pacific Railway, was elected president of the Engineering Institute of Canada at the annual meeting of the body held at Montreal recently. Mr. Sullivan succeeds the retiring president, J. M. R. Fairbairn, present chief engineer of the C.P.R. Other officers elected were as follows Vice-presidents: Brig.-Gen. C. H. Mitchell and Arthur Surveyer. Councillors: District No. 1—Jules Duchastel, George MacLeod. District No. 2—J. A. Gibault. No. 3—F. Stewart. No. 4—Lt.-Col. Alex Macphail. No. 5—R. O. Wynne Roberts. No. 6—R. F. Roanthwaite. No. 7—D. A. Ross. No. 8—A. R. Greig. No. 9—H. S. L. Wilson. No. 10—Major George A. Waltham.

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Basic Principles in Labor Relations

Included in the report of the committee on labor, adopted at last month's construction conference in Hamilton, is a set of basic principles that seems to enunciate definitely and briefly the fundamental rights of employers and employees in the building industry. The general acceptance of these basic suggestions, which have been prepared only after careful and thoughtful deliberation, would, undoubtedly, help to solve the labor problem as far as construction is concerned and would pave the way for greater co-operation and better relations between the contractors and their men.

In the preamble, it is stated that "it is realized today by public-spirited employers and workmen that their mutual interests should be considered in a spirit of co-operation" and that "in order to be lasting and beneficial, such co-operation must admit certain fundamental rights of both employers and the employed, to be carried out in the spirit of fair play." This in a few words embraces the motives that should guide and govern all the relationships of contractors and workmen. It should be first admitted that each party has certain rights, the recognition of which is essential to harmony and concord. These fundamental rights of employers and employees do not, as is often supposed, tend in opposite directions, but, rather do they follow along similar lines, admitting of their easy correlation. The acceptance by each party of the fact that the other party has certain rights and is entitled to certain privileges is the first step in the solution of labor difficulties and it was in this spirit that the A. C. B. C. I's. committee on labor undertook to enunciate its guiding principles.

Seven rules are set forth, each very clearly and very succinctly, embracing a general principle that should guide the relationships of employers and employees. Taken as a whole, they concede every possible liberty in employment relations to both employer and employees, so far as liberty can be permitted without destroying workmanship.

The first principle recognizes the necessity for both employers and employees to have some reserve or surplus to provide for contingencies—the employer to have an accumulation of reserve in order that his business may withstand the vagaries of the industrial situation; and the employee to have a surplus of income to provide for contingencies and amenities, provided that efficient service is rendered by him.

The desirability of agreements between labor and capital where a labor organization is in the ascendency, is granted in principle No. 2, the object being to stabilize the industry. Recognition is taken of the fact, however, that every individual should have the unrestricted right to work where and for whom he chooses, irrespective of his labor affiliations.

The principle laid down in the third rule of the report is that labor organizations which effect agreements with employers should not endeavor to make use of this relationship to the disadvantage of such employers, in order to wrest advantage from the employers who do not make such agreements with labor organizations.

Principle No. 4 forbids discrimination against either employer or employee in the locality where any trouble exists because of the collective action of his organization in another locality.

In the next two principles, the matter of disagreements or disputes is considered, the report urging employers and employees to use their best efforts towards the elimination of jurisdictional disputes. In settling disputes, the general principles of arbitration are considered as the basis, each party refraining from making use of the lockout or strike until the lapse of a specified period after the recommendation of the arbitration board has been made.

In the final principle, the value of apprenticeship

The Contract Record's Price Index Number

	July 1, 1914	Sept. 1, 1920	Feb. 1, 1922
Materials:			
Cement	100	232	200
Lime	100	219	175
Brick (Dry Pressed)	100	188	171
Brick (Common Stock)	100	164	171
Crushed Stone	100	187	174
Sand	100	150	140
Gravel	100	180	180
Rubble Stone	100	174	213
Hemlock	100	262	166
Pine	100	234	167
Shingles	100	292	180
Lath	100	400	255
Dimension Timber	100	250	188
Steel (Reinforcing)	100	220	116
Steel (Structural Shapes)	100	232	120
Cast Iron Pipe	100	242	182
Plaster	100	263	312
White Lead	100	237	157
Labor:			
Bricklayers	100	182	182
Plumbers	100	200	200
Painters	100	214	214
Electrical Workers	100	219	219
Carpenters	100	200	178
Common Labor	100	183	150

is recognized and special attention is urged toward the improvement of apprenticeship relations.

These principles will be seen to deal with the labor situation very fairly and liberally. Their acceptance by the contractors of Canada, at the Hamilton Conference, is an indication that the employers are ready to do their share toward co-operating with labor in the building and construction industry. In order that satisfactory results may be forthcoming, it is desirable that the workmen accept these principles at the earliest moment, so that concord and harmony may be assured and the entire industry benefitted thereby.

Old Building Remodelled to Meet Modern Office Requirements

Structural Features of Washington Building Reconstruction in New York—Lower Tier Columns Removed and Loads Carried on Heavy Plate Girders

The remarkable manner in which buildings may be remodelled to meet the present day requirements for offices has been exemplified recently in the reconstruction of the Washington Building in New York City.

This building was built in the early eighties at No. 1 Broadway. It was fourteen storeys high and of bearing wall construction, the floors being supported by the walls and interior cast iron columns. The foundations for the most part went down to rock and the walls laid up in good cement mortar which was somewhat unusual for buildings constructed in those days. It was found on examination, however, that the brick piers between windows were cut into by recesses for pipes, chimney flues etc., so that great care had to be taken not to overload the brickwork. For this reason an enormous amount of shoring and scaffolding was used when the old brick was being replaced by Indiana limestone.

Transferring of Eleven Storeys.

The main structural feature of the reconstruction was the removing of an entire row of eight columns, and two others, or ten in all, for three tiers, leaving a clear space between the Battery Place wall and the court wall. To do this it was necessary to carry the eleven storeys above on large plate girders to the wall columns. The old ground floor was removed and a new floor put in about a foot higher. This floor was carried on new plate girders running from one wall to the other. They were made double, one on either side of the column which was later removed. The old second floor was removed together with the columns above and below it. The girders on which the old columns were to rest were composed of a 48 x ⅞ in. web plate, two 8 x 6 x 1 inch flange angles and four 21 x ⅞ in. cover plates for each flange. They were 41 feet 9½ in. long.

An elaborate system of shoring was arranged to raise the girders and hold them in place in case an accident should happen to the hoisting apparatus. They were raised by means of wooden Howe trusses, which rested on the second floor from which a chain block arrangement hung. As the girders were raised into position, a timber-crib blocking was built up near each end so that the girder could not fall more than a few inches. One of these girders was raised to the required height on either side of the column to be removed and a very heavy bracket was rivetted to the column, resting slightly above the girder. In this space six steel wedges were placed, three between each bracket and girder. These wedges were 33 in. long, 6½ in. wide and 1½ in. thick at the butt, tapering down to about ⅛ in. at the other end.

The wedges were driven in until the ultimate deflection of the girder had been obtained. If this was not obtained before the wedger had been driven in as far as possible, two pair were driven in a little farther to allow the other pair to be taken out. A shim plate was inserted and the wedge driven in again. This operation was repeated for the other two pairs. In this manner the entire weight of the eleven storeys above was transferred from the column to the girders, the wedges being used to assure that the ultimate deflection had occured before the columns were removed. The wedging was spread over two weeks and the girders were deflected from ¼ in. to 25/32 in.

The next operation, after it was evident that the girders were carrying all the load, was to burn off the heavy cast iron columns. This was done by means of an acetylene gas torch. When the columns were removed, each pair of girders was connected by a pair of plate-girder diaphragms directly under the column. The space between the girders and the diaphragms is to be filled with concrete and the cast iron columns above are to be filled with grout or concrete up to the top of the bolts, from the brackets to avoid any danger of the latter rusting out.

British Industries Fair

When the eighth annual British Industries Fair opens in London and Birmingham on February 27 for its two weeks' run, buyers will be there from all parts of the world. This is the information received from the British Government Department of Overseas Trade which is responsible for the organization of the fair. The British trade commissioners in Canada, who have their offices at 248 St. James Street, Montreal, 260 Confederation Life Building, Toronto, and 610 Electric Railway Chambers, Winnipeg, state that many Canadian buyers will attend the fair.

Especial attention is directed to the impressive and comprehensive display of metals, hardware and engineering exhibited at the Birmingham section of the fair. Here the goodwill possessed by the manufacturers of Birmingham throughout the world takes tangible form, and the buyer may inspect everything of interest produced in what is universally acknowledged to be the "Workshop of the World".

Burlington Bridge, Near Hamilton, Involved Difficult Foundation Problems

Strauss Bascule Span Replaces Swing Structure—Presence of Sand for a Depth of 100 Feet Made Extensive Piling Necessary—Sheet Steel Cofferdam Enclosed Pier Sites—Continuous Pumping to Keep Water Down

By F. W. PAULIN
Vice-President and Manager, Canadian Engineering and Contracting Co., Hamilton, Ont.

At a time when interest is directed toward the projection of the Detroit River bridge and various articles are appearing in the press relative to the engineering difficulties which have been encountered in the consideration of the project, attention may be called to a work of less magnitude, but one presenting equally difficult problems.

For many years the bridge at Burlington Channel near Hamilton, Ont., used as a carrier for foot, vehicular and radial railway traffic, had been in a questionable condition, and the Dominion Department of Public Works, after investigating different styles of swing and lift bridges, decided to erect a single leaf Strauss trunnion bascule bridge, replacing the old swing structure.

In the autumn of 1920 tenders were called for the dismantling of the old swing bridge, the removal of the foundations and the construction of new foundations. On December 17th, 1920, the old swing bridge was operated for the last time, and 16 days later it had been dismantled and removed.

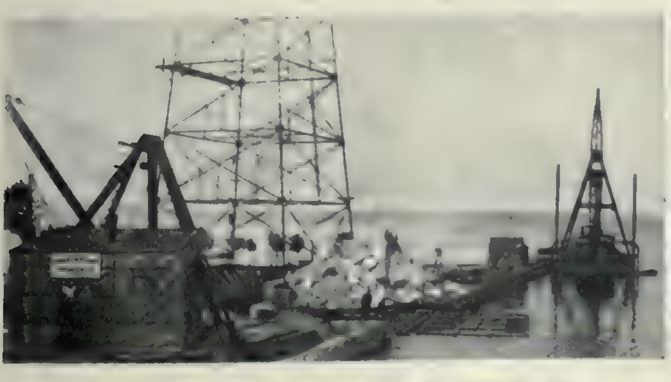
The construction of a bascule bridge requires three distinct piers, each designed to perform a particular duty. They are known as the counterweight, the main trunnion, and the rest piers. In this case the counterweight of the bridge consists of a block of concrete suspended in the air, and weighing approximately 700 tons. The counterweight pier is therefore designed to take the weight of the bridge plus the weight of the counterweight or approximately 1400 tons.

Driving the dam for the main trunnion pier of the Burlington bridge

Piers Carried on Piles

The nature of the formation, which is a fine sharp sand for a depth of over 100 feet, made it necessary to drive piles to take the load and in the case of the conterweight pier 102 40-ft. 14-in. southern pine poles were driven after the cofferdam had been constructed, and an excavation of 15 ft. deep had been made and unwatered. On top of the piles the concrete foundation, properly reinforced, was constructed. This work extended over the winter months and on May 1st when the danger from storms had passed, the main trunnion pier was commenced.

The function of this pier is to take lift as well as



Placing cage bracing for dam for main trunnion pier

Excavating for main trunnion pier. The pile of stone is from the old bridge foundations load. It is therefore necessary that it should be well and truly laid. In this case it was necessary first to remove the old masonry-filled crib which was done by a careful use of dynamite placed by a diver. The old crib was then pulled by means of a floating derrick to which was attached a powerful orange peel bucket. A cross cut was made in the crib and so carefully was it done that in places there was not over an inch clearance when the steel cofferdam was driven. Lackawanna steel sheet piling of 14 in. arch web section, 45 ft. long, was used in the dam, the cage bracing being B. C. fir 12 in. x 14 in. timbers framed and floated into position before the steel was driven.

Water Troubles

The cofferdam was driven in four days and when closure was made the last leaf slipped into place like a leaf in a book. The pumps were then put to work and the dam was unwatered to a depth of 30 ft. below the top of the wharf when 100 40-ft. 14-in. southern pine poles were driven in the bottom of the hole. At this point great difficulty was encountered on account of the nature of the bottom, the excessive water pressure on the outside of the dam and the necessity of using a powerful water jet to drive the wooden piles to a point 70 feet below the top of the wharf. Due to incessant supervision only once did any damage occur from this cause. On that occasion, with ten men working in the bottom of the dam, the water pressure found a soft spot in the bottom and the dam filled in 1½ minutes. No one was hurt but all were given a quick free bath. The weakness was overcome by means of filling in the outside of the dam with clay, sod, cinders, manure and stone and two days after the blow the men were again working in the bottom of the hole.

For three months the pumps were kept in operation day and night, as it would mean possible failure if the dam had been allowed to fill. When the piles were driven and the concrete poured, the dam was allowed to fill with water and was later removed to admit of the backfill being made.

The rest pier was constructed in a manner similar to the counterweight pier but did not present the same difficulty. This work was completed by September 1st ready for the erection of the steel, and it was found when checked over by the Hamilton Bridge Works' engineer to be almost theoretically correct as to relative position and elevation of piers.

The work was designed by the Department of Public Works of Canada, of which Mr. J. M. Wilson, C. E., is the district engineer, and Mr. Walter Brough the engineer in charge of the work. The Canadian Engineering and Contracting Co., Ltd., Hamilton, Ont., of which Mr. Paulin is manager, performed the work. The steel superstructure is being fabricated and erected by the Hamilton Bridge Works, Ltd.

No Hydro-Electric Plant in West Vancouver

At the municipal elections in West Vancouver municipality, a suburban district across Burrard Inlet from Vancouver City, the proposal to raise $90,000 debentures for the purpose of financing the installation of a municipal hydro-electric plant on Cypress Creek, was turned down because the proposal lacked 20 votes of the necessary three-fifths in favor. There was an actual majority of 58 votes in favor of the plan, which is popular with the ratepayers, who will now have to wait another year before submitting the by-law again.

Wages Drop in Victoria, B. C.

Contractors' Organizations on the Coast are Discussing Schedules— No Action in Vancouver Yet

Contractors' and builders' associations on the Pacific Coast are wrestling with the wage schedules in the building trades, preparatory to figuring on the coming season's building activities. The year 1921 saw little disturbance in the building trades, either in wage rates or in conditions of employment. There was almost a clean sheet with respect to strikes, with some minor exceptions. Possibly one of the causes for the minimum record was that the rates of pay were disturbed very little—in many cases not at all. In this the building trade employees were particularly fortunate. In other industries, particularly the lumber industry, very drastic cuts were given to the pay schedules.

Victoria Reduces Wages

Vancouver's General Contractors' and Master Builders' Association has not yet come to any decision, though the general subject has been under discussion a number of times. Victoria city's Builders' Exchange held a meeting on January 23, when about one hundred members attended. The reduction of wages, as a means of bringing down the cost of construction, and thereby stimulating building, was considered as an important factor. By a reasonable reduction it was felt that the men themselves would directly benefit through increased employment. It was also pointed out that the cost of living had been materially reduced since the existing schedule of wages in the building trades in Victoria had been fixed. In conformity with the views expressed, a new schedule was drawn up, to become effective on February 17. This new scale and the old scale now in force are as follows:

	Wages per day	
	Present Rate	New Rate
Carpenters	$6.00	$5.00
Painters	5.60	4.80
Plumbers	7.20	6.00
Masons	8.00	6.80
Plasterers	8.00	6.80
Stonecutters	8.00	6.80
Electricians	7.00	6.00
Sheet Metal Workers	6.40	6.00
Laborers	4.50 to 4.00	4.00 to 3.50

New Bulletin Issued by A. S. M. E.

The American Society of Mechanical Engineers is issuing semi-monthly a news bulletin entitled the 'A. S. M. E. News", which supersedes the society affairs section of the "Mechanical Engineer". The new publication will carry information regarding the activities of the society, its local sections and professional divisions, and will add greatly to the value of the employment service as well as reduce the time necessary for the election of new members.

Wage Cut in Halifax

The Mechanical Trades Exchange, at Halifax, recently announced a general cut of 15 per cent. in wages, effecting all building trades. This reduction has already been put into effect.

Construction Developments During the Month of January

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction activity in Canada according to figures compiled by MacLean Building Reports, Limited, during the month of January, amounted to $8,392,600, compared with $8,947,500 in January 1921. The figures for the different Provinces are as follows:—Ontario, 380 projects valued at $6,609,200; Quebec, 74 projects valued at $640,600; British Columbia, 74 projects valued at $632,800; Nova Scotia, 11 projects valued at $248,000; New Brunswick, 12 projects valued at $154,000; Saskatchewan, 5 projects valued at $40,500; Manitoba, 9 projects valued at $37,500; Alberta, 6 projects valued at $30,000; total for Dominion, 571 projects valued at $8,392,000.

Increased Activity in Sight

During January the value of building and engineering work reported for the first time as contemplated reached the impressive total of $22,391,600. This represents cost of 529 different projects reported by MacLean Building Reports Limited, during January, and serves as a reliable forecast of work to be undertaken in a month or two. The figures are as follows:—Western provinces, 64 projects valued at $8,625,100; Ontario, 292 projects valued at $8,584,900; Quebec, 162 projects valued at $4,581,600; Maritime provinces, 11 projects valued at $600,000. Total 529 projects worth $22,391,600.

Ontario Continues to Lead

Ontario continues to hold first place among provinces having 47.5 per cent of the total construction for 1921 against Quebec's 25.5 per cent; the West's 23.2 per cent and the Maritime's 3.8 per cent..

Active Residential Building Promised

During 1922, residential building will undoubtedly be active at approximately the present levels of cost. There will also be much better activity along the lines of railroad and public utility rehabilitation. In industrial building little can be expected at least until we have seen several months of decidedly more active business than that of present levels. Extensive road building programs of the provincial governments promise more active public con-

Construction Contracts Awarded in Eastern Canada, January, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	3	$ 72,000	....	$........	....	$........	....	$........	3	$ 72,000
Churches	2	33,000	....	....	....	....	....	....	2	33,000
Factories	8	199,000	3	74,000	....	....	....	....	11	273,000
Public Garages	4	22,000	....	....	....	....	....	....	4	22,000
Hospitals	....	....	....	....	1	5,000	....	....	1	5,000
Office Buildings	1	26,000	1	3,000	....	....	....	....	2	23,000
Public Buildings	1	5,000	....	....	....	....	1	32,000	2	37,000
Residences	303	1,680,800	60	333,800	9	47,000	5	26,500	377	2,088,100
Schools	4	744,000	1	4,000	....	....	....	....	5	748,000
Stores	42	567,000	6	139,800	1	6,000	....	....	49	712,800
Warehouses	3	79,200	....	....	....	....	....	....	3	79,200
Total Buildings	371	$3,422,000	71	$554,600	11	$ 58,000	6	$ 58,500	459	$4,093,100
Bridges	....	$........	....	$........	....	$........	1	$ 3,500	1	$ 3,500
Dams and Wharves	2	65,000	....	....	....	....	....	....	2	65,000
Sewers and Watermains	3	55,200	1	34,000	....	....	3	181,000	7	270,200
Roads and Streets	1	4,000	2	52,000	1	96,000	....	....	4	152,000
General Engineering	3	3,063,000	....	....	....	....	1	5,000	4	3,068,000
Grand Total	380	$6,609,200	74	$640,600	22	$151,000	11	$248,000	477	$7,651,800

Construction Contracts Awarded in Western Canada, January, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	1	$ 10,000	....	$........	....	$........	....	$........	1	$ 10,000
Factories	3	15,500	....	....	....	....	....	....	3	15,500
Public Garages	4	19,500	1	20,000	....	....	1	11,000	6	50,500
Office Buildings	....	....	....	....	....	....	1	1,600	1	1,600
Public Buildings	1	2,500	1	1,500	....	....	....	....	2	4,000
Residences	45	160,600	3	6,500	4	10,500	4	16,000	56	193,600
Schools	2	9,600	....	....	....	....	....	....	2	9,600
Stores	9	27,000	1	2,000	....	....	3	8,900	13	37,900
Warehouses	1	20,000	....	....	....	....	....	....	1	20,000
Total Buildings	66	$264,700	6	$30,000	4	$10,500	9	$37,500	85	$342,700
Dams and Wharves	3	$ 19,300	....	$........	....	$........	....	$........	3	$ 19,300
Sewers and Watermains	2	165,000	....	....	....	....	....	....	2	165,000
Roads and Streets	1	45,300	....	....	....	....	....	....	1	45,300
General Engineering	2	138,500	....	....	1	30,000	....	....	3	168,500
Grand Total	74	$632,800	6	$30,000	5	$40,500	9	$37,500	94	$740,800

Contemplated New Construction Work in Canada, January, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value.	No.	Value	No.	Value	No.	Value
Apartments	7	$ 200,000	1	$ 60,000	....	$........	2	$ 120,000	10	$ 380,000
Churches	11	285,000	1	30,000	1	200,000	3	55,000	16	570,000
Factories	18	421,000	1	160,000	....	....	8	779,500	25	1,360,500
Public Garages	10	143,000	1	15,000	....	....	3	38,000	14	196,000
Hospitals	4	425,000	....	....	....	....	1	20,000	5	445,000
Hotels and Clubs	10	387,000	5	620,000	....	....	....	....	15	1,007,000
Office Buildings	7	602,000	1	50,000	....	....	3	436,000	11	1,088,000
Public Buildings	9	224,000	2	85,000	2	37,000	4	29,000	17	375,000
Residences	97	485,900	100	531,000	1	8,000	3	18,500	201	1,043,400
Schools	41	3,133,000	7	748,000	1	125,000	13	213,000	62	4,219,000
Stores	21	372,000	2	65,000	....	....	7	59,400	30	496,400
Theatres	....	....	....	....	1	10,000	....	....	1	10,000
Warehouses	10	337,000	2	112,000	....	....	1	35,000	13	484,000
Total Buildings	240	$7,014,900	126	$2,476,000	6	$380,000	48	$1,803,400	420	$11,674,300
Bridges	3	$ 394,000	2	$ 170,000	....	$........	2	$ 18,000	7	$ 582,000
Dams and Wharves	1	10,000	....	....	....	....	2	2,013,000	3	2,023,000
Sewers and Watermains	25	506,000	28	1,749,600	3	95,000	5	1,384,000	61	3,734,600
Roads and Streets	16	320,000	6	186,000	2	125,000	3	340,700	27	971,700
General Engineering	7	340,000	....	....	....	....	4	3,066,000	11	3,406,000
Grand Total	292	$8,584,900	162	$4,581,600	11	$600,000	64	$8,625,100	529	$22,391,600

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
January, 1922	$ 6,609,200	$ 640,600	$ 402,000	$ 740,800	$ 8,392,600
January, 1921	2,643,600	1,261,200	96,900	4,945,800	8,947,500
January, 1920	6,361,500	8,235,200	519,000	949,800	16,065,500
January, 1919	1,000,000	142,000	260,100	1,582,200	2,984,300
January, 1918	1,668,900	1,845,200	1,253,400	957,300	5,724,800

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
January, 1922	$2,363,700	1,783,600	288,500	3,956,800	8,392,600
January, 1921	1,226,500	2,520,800	271,000	4,929,200	8,947,500
January, 1920	1,383,100	5,788,400	8,293,400	600,600	16,065,500
January, 1919	650,800	1,072,300	66,500	1,194,700	2,984,300
January, 1918	903,800	1,732,000	2,269,700	819,300	5,724,800

CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY, 1922.

	Ontario		Quebec		Maritime		Western	
	No.	Value	No.	Value	No.	Value	No.	Value
Residential Buildings	306	$1,752,800	60	$333,800	14	$ 73,500	57	$203,600
Business Buildings	57	1,470,200	8	146,800	3	43,000	25	123,600
Industrial Buildings	8	199,000	3	74,000	....	....	3	15,500
Public Works and Utilities	9	3,187,200	3	86,000	6	285,500	9	398,100

struction work than during 1921. The winter is rapidly passing, without any particular severity, or any economic upset such as was apprehended six months ago.

Cancellation of Plans for Large Public Works on the Coast

Dry Docks at Victoria and Vancouver Held Up—Construction Expected to Proceed on Ballantyne Pier

Cancellation of plans for large public works in the coast section of British Columbia seems to be imminent, following definite instructions from Ottawa to stop all work on proposed construction. This has been made to apply to the dry-dock at Victoria, on which work has been going ahead for some time, and for which a contract had been entered into and under which contract a great deal of expenditure is already committed, and which will no doubt have to be written off if the work is finally cancelled. The proposed floating dry-dock at Vancouver has also been held up. The promoters, a combination of the Wallace and Couglan shipyard interests, have been going ahead with preliminary arrangements at North Vancouver, on the north shore of the Harbor, and it was fully expected that the construction of the first unit would go right ahead. At the present time, work on the Ballantyne Pier, another Dominion Government enterprise in Vancouver Harbor, is well on its way to completion, and while some nervousness has been displayed with regard to it, there has been no word of even holding up construction. This very important and necessary—and long-delayed—addition to the harbor facilities of Canada's Pacific mainland port is not only too near completion, but is so vital to the interests of Canada's commerce that there is no real danger of suspension of work on it.

In contrast to the temporary holding up of these works, the announcement is made from western headquarters of the C. P. R., by Mr. D. C. Coleman, western vice-president, that the company has decided on immediate completion of its new pier in Vancouver harbor, work on which has been suspended for over a year. The dredging and refilling with gravel for the core of the pier, which is to be of permanent reinforced concrete construction, was completed and then the financial situation caused the decision to hold back the erection of the superstructure. This is but one of a series of large piers which are included in the C. P. R. scheme of development of its section of the Vancouver water frontage. Two others have been in commission for a number of years, in addition to the use of the dockage along the entire frontage owned by the company.

Descriptive Catalogue of Wood Stave Pipe

In a well arranged and excellently printed booklet of moderate proportions, the chief features, methods of construction, and uses of wood stave pipe in its two principal forms, wire-wound and continuous stave, are presented by the Pacific Coast Pipe Co., Ltd., of Vancouver. This new publication, just completed, will be read with close attention by engineers and contractors. In a foreword, the publishers state that it is not their intention to enter into an argument on the relative merits of wood pipe, confining their pages to a description of the product of their factory, including some account of its actual use in the many systems where it has been installed and successfully operated. This field covers domestic water supply, irrigation and hydro-electric installations.

A brief outline of the history of wood pipe, first used in bored form, and instanced as far back as the Roman era and the earliest waterworks installed in London, are given. The modern form, wood stave pipe, whether wire-wound or in continuous construction, is carefully and concisely described, and the text is illustrated with views showing mains laid for many purposes. The care in selecting and preparing the staves—Douglas fir being the material used—is explained, and clear directions for laying the pipe and making connections are given. Wood staves for tanks, silos, irrigation flumes, and many other purposes are shown. The widely extended use of this form of water service in recent years, and extending back a third of a century, as well as improvements steadily made, are recorded, an astonishingly large mileage having been used in many parts of the world.

Good Roads Meeting in Victoria

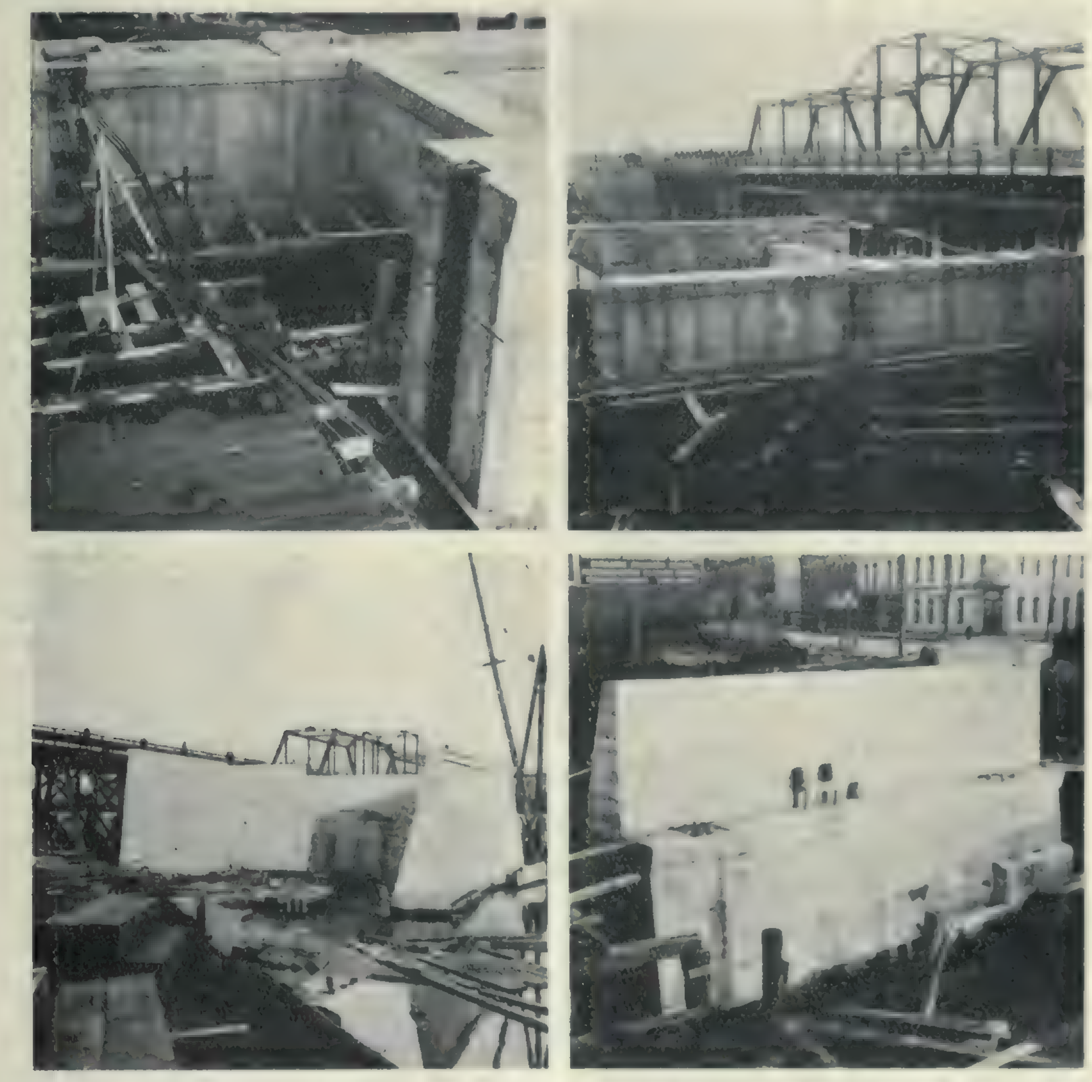
Arrangements have been made by the executive of the Canadian Good Roads Association to hold this year's convention in Victoria B. C., from June 13 to 16

Johnson St. Bridge, Victoria, B.C.

Substructure Practically Finished and Steel Erection to Commence Soon--Interesting Methods of Providing Bond Between Completed and Future Work

By the Contract Record's Victoria, B. C., correspondent.

With the exception of work which must be left until after the demolition of the present bridge, work on the foundations and piers for the new bridge across Victoria Harbour is rapidly nearing completion. The west abutment is completed and is now being filled in with the material excavated from the site of the western pier. The main pier is almost completed, but cannot be finished at present, as the old swing-span centre pier is in the way. The photographs clearly show the portions built, with the arrangements for bonding the remaining portions when construction proceeds.



Upper left: Showing reinforcement and keyways left for second stage of construction. Upper right: Trunnion Pier showing relation to old bridge. Lower left: West abutment completed. Lower right: Completed portion of east abutment.

A rather interesting detail in this connection is the method adopted with the steel reinforcement, which it will be noted has been installed complete for the missing longitudinal cell-wall and is supported by timbers etc., in the meantime. A more useful practice would have been to leave stubs of generous length for wiring on the steel when the forms were built, but it was considered in this case that an additional degree of safety would be attained by making the steel continuous.

A portion of the east abutment has also been left for future construction. This being built of mass concrete, no attempt has been made to provide a steel connection between the two portions, but, large keyways about two feet in depth have been left in the cross section of the wall, which will provide sufficient bond.

Steel erection is expected to commence as soon as the first shipment of bridge secions, which is now en route, comes to hand. The grillages and anchor bolts for embedding in the concrete were received some little time ago and are already in place on the substructure. Tenders are now being called for the remaining half of the steel superstructure, which includes the railway traffic section. The electrical and mechanical portions are being handled by the Canadian General Electric Company, who are collaborating with Messrs. Fraser and Frew of Vancouver, electrical and mechanical engineers, on the erection and problems of the design of the operating machinery.

Although the two parts of the bridge will be structurally independent, they will be linked for operation, and only one operating house will be provided.

Where Paper Profits in Highway Construction Disappear

Various Factors Which, if not Properly Taken Into Account by Contractors, Will Cause Supposed Profits to Turn Into Losses—Careful Study and Experience Only Will Minimize the Uncertainties of Contracting

By HENRY H. WILSON
Managing Partner, Winston & Co., Muncy, Pa.

Paper read before the Associated General Contractors of America.
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In the first place, and dismissing such extraordinary considerations as war and post-war conditions, it is safe to say that more losses have been encountered by highway constructors through careless estimating and failure to analyze and anticipate many factors to be encountered than from all other causes. If a contractor is to be successful, he must exercise in the preparation of his bid the same degree of diligence and intelligence that he is willing and expects to exercise in the prosecution of the work after the contract is awarded him. Every contractor, who would be a successful bidder, in the final meaning of that term, must be "from Missouri". He must ascertain, from careful study, just what he is doing when he submits a bid and not rely upon somebody else's judgment. In time past, there has often been a tendency among contractors to take engineers' estimates on work as final criteria of the costs of same and to figure their bids below those estimates, with the apparent conviction that the gentlemen computing these estimates possess some occult powers of divination and that it was not possible for bidders to lose money so long as their bids remained within hailing distance of these estimates. This will not do. Engineers have an almost universal tendency to underestimate costs, because they do not pay the bills for work and it is difficult for anyone who does not pay the bills to take into account the many theoretically hidden items of expense which, in practice, discover themselves to the contractor.

Engineers' Estimates Mislead Contractors

Further than this, the estimator of one of the leading highway departments of the country said to me some years ago: "In making estimates, I do not attempt to figure what I think the work should really cost but what I think the contractors will bid. If I turned in estimates to my department, based on my own judgment of the costs involved, the contractors would soon make my figures look foolish". This statement is pregnant with suggestion as to where many paper profits of constructors have disappeared in the past. It is believed that one of the greatest steps taken in recent years with a view to eliminating the irresponsible constructor, has been the refusal of some highway departments to give out engineers' estimates in advance of the letting of work.

In addition to the losses resulting from a too high regard for engineers' estimates, cases are not wanting where would-be constructors have been willing to leave the preparation of their bids to some material or bonding man, who was instrumental in interesting them in their efforts to secure work. None of us who have worked for any considerable number of years in the highway industry have failed to be conscious of the annual crop of new concerns with more enthusiasm than practical experience and who have, oftentimes, been brought "into the field" through the efforts of some vendor bent upon securing a portion of his client's business after he secures an award. In his experience in the highway construction business, the writer has, more than once, seen a condition of affairs existing where concerns practically without capital, experience or equipment, were furnished not only with certified checks but with a complete set of bidding figures as well, by some interested vendor. It is almost superfluous to say that the paper profits figured for many constructors of this type were not long in winging their flight.

Tenders by Unqualified Estimators

Much loss has also been experienced due to attempts of unqualified estimators to apply cost data gleaned from hand books and trade literature upon the subjects. Such data are good for bidding purposes only in so far as one is qualified, by study and analysis, to properly interpret and apply them to new conditions. Unless one is so qualified, an attempt to use such data is like fooling with the proverbial "buzz-saw",and it is not surprising that many paper profits so arrived at have promptly disappeared.

Cases are not wanting where bidders have submitted prices merely made to beat the previous low bidders, evidently and solely in the child-like faith that the previous low bidders could have made no mistake. Bids have also been submitted which were nothing more than an average of the bids submitted upon a number of other projects, all of which might have been entirely dissimilar from the projects they were used to average on. Such practices as the last two mentioned are only comparable to trying to raise oneself by the boot-straps and have met with about the same measure of success.

Even where constructors have possessed the necessary qualifications for careful analysis and estimating, very considerable paper profits have disappeared through failure to give the subject the time necessary for the completion of a thoughtful bid.

Under existing highway laws, nearly all specifications require the contractor to assume many elements of risk and uncertainty which should properly be assumed by the states or provinces. So long as this condition of affairs exists, it is important that constructors cover these elements in their bids by a proper percentage of probable occurrence. Many paper profits have undoubtedly disappeared through failures to do this.

Elements of Risk and Uncertainty.

In a report of the specifications committee of a State Highway Constructors' Association, it was stated to be the belief of said committee that, in the state whose specifications were under discussion by them, at least fifteen per cent. of the net estimated cost of a project should be added to cover elements of risk and uncertainty included in all contracts. The committee making this report, consisted of five experienced highway constructors, three of whom were members of the American Society of Civil Engineers (one being a director of that society and another the ex-chief engineer of a great state's highway department). It will, therefore, be seen that a majority of this committee had had practical experience with the working of highway specifications, from "both sides of the street". Their report deserves to be received with respect and careful consideration by constructors everywhere and the verdict rendered by them in the connection referred to is another sermon on where paper profits disappear.

The constructor who is saddled with an enormous plant investment, on which he has earned little or no depreciation, will say that in bidding be is faced, not with the question of what he ought to do in such matters but with what he must do in order to secure further work and that, so long as "he is in Rome, he must do as the Romans do", and compete with other bidders who do not consider the above risks. This position upon the part of certain constructors, reminds one of Bryden's satire upon the writers of the time of Charles the Second:

"The poets who must live by Courts or starve,
Were proud so good a government to serve,
And seeking to serve their base and selfish ends,
Polluted the stage for some small snip of gain."

Many highway constructors continue to "pollute" the best interests of themselves and their competitors by bidding prices which do not take proper account of the hardships so frequently resulting from the elements of risk and uncertainty included in most highway contracts. Highway departments and engineers have long recognized this tendency and the apparent helplessness upon the part of constructors and some of them have not failed to take advantage of it to the limit.

Like the law of action and reaction, construction costs and first class work are believed, in the final analysis, to be direct variables in most cases and fairly well balanced. It is hard for highway departments to get something for nothing and it will, doubtless, generally be found, where risky bids have been accepted, that what is gained in first cost will ultimately be sacrificed either in speed or quality.

Conduct Contracting on Business Principles.

In further relation to the matter of risks included in contracts, the average constructor will say that if he undertook to add anything like 15 per cent. to his estimated cost of work to cover the elements of risk and uncertainty, he would never get a job. The only answer to this question is that if constructors knowingly assume risks without under-writing them, they are not constructors at all, in the real meaning of that term. Such concerns do not deserve to be classed as business ones but simply as gamblers and economic pariahs, as menaces to themselves, their fellow contractors and the public as well. Any insurance company or other well-ordered business conducting its business upon such lines would soon end in bankruptcy and, given enough time, any construction concern following such practice will eventually come to grief. In order to be ultimately successful, constructors must conduct their estimating and operations upon well established principles.

When highway constructors, as a class, come to a fuller realization of this principle, they will find that a considerable amount of the paper profits which often disappear due to friction with highway departments, prosecution of claims, and discouragement in the esprit de corps of their organization, will be saved to them. It is also believed that nothing like the elimination of these elements of risk and uncertainty in specifications (or else the proper covering of them in bids) will go so far towards building up the efficient and long lived highway constructing organizations which will be found to be such a rarity at the present time when both qualifications referred to are considered. When this has been accomplished, it is also believed that there will be fewer abandoned contracts and insolvent constructors, less loss, trouble and expense to the public in being deprived of the use of its highways through delayed and unsatisfactory work, a saving to the taxpayers in cheaper work resulting from the elimination of all risks possible and more efficient construction organization and lower engineering costs to the provinces and states through more expeditious execution of work.

It will not be amiss to attempt to point out herein some of the other considerations which are believed to be essential to the preparation of a conservative bid upon the major items of work found upon practically all highway projects, failure to recognize any one of which cause disappearance of paper profits.

General Contract Factors.

(a) Failure to recognize the fact that, in normal times, a contract located close to large centers of population and production, cannot usually be prosecuted on as economical a wage scale as one comparatively removed from competition in this line.

(b) Use in bidding of lowest quotations on aggregates, without careful examination into the character, suitability, and possibilities for future rejection of the same, as well as the producer's ability to furnish the maximum amount of material when and as required.

(c) Failure to study availability of cars and train so as to permit a producer of small capacity, upon whom one may have to depend, to make shipments evenly at all times, or to enable stocking of materials to cover strikes, embargoes and other contingencies.

(d) Failure to study available labor supply and prices likely to prevail for same during the life of a contract.

(e) Failure to study availability of cars and train movements involved with material shipments.

(f) Failure to consider whether one will be able to perform a prospective contract with an old and experienced organization or with a new organization to be assembled for the work in question.

(g) Failure to properly consider probable duration of working season and the expense incident to carrying an organization through the winter, particularly where this expense results from inability to complete project in one season as may be contemplated when submitting bid.

(h) Failure to recognize fact that existing sidings for delivery of material may prove inadequate for proper prosecution of work and protection of progress and to include expense for construction of additional sidings or extension of existing facilities.

(i) Failure to consider suitability and volume of water supply and the charge for additional equipment which may be necessitated through failure at any time of an anticipated source of supply.

(j) Failure to properly consider character of roads available for hauling and the resulting costs under all weather conditions.

(k) Failure to investigate or consider, as far as practicable, character of engineers and inspectors to be dealt with.

(l) Failure to charge off the amount of plant depreciation which may be experienced from a falling market, unsatisfactory machinery purchased, or failure to complete work in anticipated time.

(m) Failure to properly analyze and consider soil, and topographic conditions, right of way problems and any structural obstacles along right-of-way, in their relation to wet weather, progress, transportation and resulting costs.

(n)Failure to provide for proper and economical sequence of operations and for the most satisfactory and economical equipment for executing work in hand.

(o) Failure to charge on estimate for the cost of freight and handling on many small items of supplies, insignificant in themselves individually, but amounting to a large sum in the aggregate.

(p) Failure to investigate cost of supplies such as lumber, coal, feed etc., also leases, rentals, freight on plant, camps, warehouses, plant, travelling expenses, losses on transportation of labor, legal expenses and many items which might be mentioned, in their relation to a particular contract. As an instance of what is meant by the last named phrase, it will generally be found that, on contracts with heavy excavation and masonry quantities (involving use of steam shovels, additional mixers, water lines and other accessories) the cost of items of supplies, repair parts, shop work, etc. will considerably exceed (both in amount and in percentage of labor) what would be incurred where excavation and masonry quantities are light. Likewise, the expense for tools will vary greatly according to the number of outfits you will be required to use as well as according to the personnel and efficiency of your organization. It is not amiss to point out here that the expense for repair parts and shop work will increase considerably and directly in proportion to the age of your equipment.

(q) Failure to recognize that costs used in compiling a bid may have been achieved under the direction of a more competent superintendent and efficient organization than you will be able to secure for the prospective project.

(r) Failure to properly consider the existing condition and probable course of the markets during the life of a contract. This factor must always be balanced against cost figures procured from a contract already executed.

Major Contract Items.

The preparation of a bid upon the excavation embraced in a highway contract is believed to be one of the most prolific sources for the disappearance of paper profits. It is doubtful if any other item of a road contract holds such possibilities for loss. In proportion to its relative value in determining profit or loss, excavation probably receives from the average bidder less careful and painstaking attention than any other contract item. Many constructors appear to bid excavation at about what they estimate the actual labor cost of performing it to be, without giving any thought to the fact that it is one of the principal items in almost every highway contract and should properly take care of a very considerable portion of the overhead expense and profit. Paper profits on excavation may disappear through failure to properly appraise any of the following factors.

(a) Failure to study all excavation involved in the field and work out in advance of bidding an approximate classification of materials to be handled in grading, foundations, ditches, borrow pits, shoulders, dressing slopes, refilling rock breakage in cuts, etc. Almost any constructor can tell you what the total unit cost of excavation was on a particular job but few can tell how many yards were handled of each of the various classes of material by a particular method and the resulting unit costs. Because of the difficulty and expense necessary to properly keep such costs, we not only find contractors' records, but the actual technical literature in existence, on this particular subject, very barren. After all pains and technique have been exhausted, however, we are still forced to admit that any estimate upon road excavation will, doubtless, vary more widely from the actual costs experienced than the estimate upon any other item in a highway contract. Under these conditions, one might think that constructors would proceed with more caution and be less inclined to flirt with the danger line, in bidding on this item, than on any other item of a contract, but no such impression can be justified by the history of costs in recent years.

(b) Failure to estimate even approximately on the amount of fence moving, sod, clearing, scarifying and other items which may be included in the excavation price.

(c) Failure to approximate average length of haul or overhaul on excavation and borrow.

(d) Failure to recognize that, on most road construction in cuts, it is impracticable not to excavate a large portion and then replace same without payment for either operation.

(e) Incurring heavy demurrage charges through failure to provide for orderly shipment and unloading of materials. The writer heard of one highway constructor in the East who was forced to pay several thousand dollars demurrage in a single season through accumulation of cars, due to carelessness in design of unloading plant and ordering of shipments.

(f) Failure to allow in the estimate for the expense of stocking and rehandling materials and for waste in materials incident thereto.

(g) Failure to properly figure average haul on excavation and materials for pavement and masonry for the work as a whole.

(h) Failure to figure cost of steel bars, pins and filler required for expansion joints.

(i) Failure to figure shrinkage as between loose measure and solid measure in the construction of subbase, broken stone base and other foundation courses.

(j) Failure, in bidding on masonery work to recognize the great variation in the unit costs of labor and other expenses, as between bridges, walls and other heavy masonry and pipe head walls. Aside from bridge parapets, the construction of head walls will be found to be, comparatively, much more expensive than other masonry quantities, not only in labor but also in waste of material as well. As an instance of this, on a road project built in 1920, the cost of rubbing down head walls, with labor at $4.50 per day, was found to be thirty cents per cubic yard of concrete placed in head walls.

(h) Failure to make proper charge for supplies required in connection with concrete masonry, tile underdrains and other miscellaneous items of contract work.

Conclusion.

In conclusion, it may be said that there is no "royal road" either to the best estimating or the prevention of the disappearance of paper profits. To the close student of the subject, however, this fundamental thought should always suggest itself. No matter how many uncertainties may enter into the preparation of an estimate, the moment you eliminate or neutralize one of these uncertainties by careful analysis or study, you are correspondingly closer to the actual result than if you guessed at them all. As has been said before, no scheme will ever be devised or charts drawn so that a novice can make highway estimates. By the same token, nothing will ever be promulgated or known which will entirely eliminate the disappearance of paper profits. However, through use of brains, intelligent interpretation and application of previous costs, as well as a study and knowledge of conditions influencing costs, risks can be greatly minimized and a much more accurate and conservative result obtained than is possible by any other human methods. "Every tub must stand on its own bottom" Your aptitude in eliminating the disappearance of paper profits will have to be built on experience and study in the actual conduct of construction.

Annual Meeting of the E. I. C.

Two-Day Gathering in Montreal for Reception of Reports and Transaction of New Business—Winnipeg Meeting Postponed Until September

The 26th annual meeting of the Engineering Institute of Canada was held in the headquarters of the society, in Montreal, on January 24 and 25. Owing to the necessity for postponing the annual and professional meeting, scheduled to be held in Winnipeg on Feb. 21, 22 and 23, this meeting had more of a business character and did not embrace as lengthy or as varied a program as is usually arranged. A brief report of the proceedings follows, this having been withheld owing to the early publicationof the last issue of the Contract Record.

Mr. J. M. R. Fairbairn, president of the Institute occupied the chair during the session on the morning of Tuesday, January 24. After the presentation and adoption of the minutes of the last annual meeting, the reports of council and committees were presented. Council's report, presented by Secretary F. S. Keith, drew attention to the very promising outlook for the coming year in the matter of engineering operations. It was recommended that the committee on policy hold another meeting shortly to put into final form matters coming under its consideration. Council also reported that the committee on classification and remuneration has so completed its work that its report will soon be ready for discussion and suggestion.

An increase in membership of about 15 per cent. during the past year was reported by council, the present membership totalling 4,688 including 10 honorary members, 1,018 members, 2,285 associate members, 438 junior, 899 students and 38 associates. Three new branches were established during the past year, namely, London, Ont., Lethbridge, Alta., Cape Breton, N. S.

Finances of the Institute

R. A. Ross, chairman of the finance committee, presented the report showing a balance of $10,313 as surplus of revenue over expenditures, only $155 less than the estimated surplus appearing in the budget prepared early in 1921. The past year was the first year during which the financial affairs of the institute were conducted on the budget system.

The report of the committee on legislation and bylaws (W. J. Francis, chairman) stated that the committee confidently believes in the attainment of protection for the profession in the very near future. "This end cannot be reached by us, however," continues the report, "until its need is fully recognized by everyone engaged in any branch of the profession, as well as by our legislators and it is more that ever incumbent upon us to act in such a way that the public will appreciate our high ideals and recognize the wonderful part the engineer is playing."

Concrete in Alkali Soils

The committee on deterioration of concrete in alkali soils announced the receipt of contributions to its funds totaling $13,200.

Approval was asked of the appointment of Dr. T. Thorwaldson, professor of chemistry at the University of Saskatchewan, as chief chemist in charge of the committee's chemical research. This was later approved on the understanding that the Engineering Institute of Canada as a whole should not be responsible for his salary. The request was made that the scope of this committee's investigations be extended to include deterioration of concrete in sea water. It was decided, however, that it would be wise to confine the committee's efforts to the solution of what is more essentially a Canadian national problem and not overlap with the work of many committees all over the world, that have been investigating the sea water problem.

Other reports were presented by the library and house committee, papers committee, publications committee, publicity committee, civil service classification committee, Canadian national committee on the international electro-technical commission.

J. G. Sullivan, president

In the afternoon session, on January 24, Mr. H. G. Acres read a petition from the Ontario Provincial Division, to amend the bylaws so as to make every retiring branch secretary an ex-officio member of the branch executive for a period of one year following his retirement as secretary. After considerable discussion, it was decided to put the proposed amendment to letter bollot.

Resolutions expressing regret on the death of Eugene D. Lafleur and Sir John Kennedy were adopted.

The routine reports of the branches and of the Ontario Provincial Division were then received and adopted.

The officers, as reported by the scrutineers, were as follows:—

President—J. G. Sullivan, consulting engineer, Winnipeg.

Vice-president—Gen. C. H. Mitchell, dean of the Faculty of Applied Science and Engineering, University of Toronto; and Arthur Surveyer, consulting engineer, Montreal.

Councillors—Geo. McLeod, engineer of sewers, City Hall, Montreal; J. Duchastel, city engineer, Outremont; J. E. Gibault, division engineer, C. N. R., Levis, Que.; A. F. Stewart, chief engineer, C. N. R., Moncton, N. B.; Col. Alex. Macphail, Queen's University, Kingston; R. O. Wynne-Roberts, consulting engineer, Toronto; C. H. E. Rounthwaite, Sault Ste. Marie; Lt-Col. D. A. Ross, consulting engineer, Winnipeg; Prof. A. R. Greig, University of Saskatchewan; R. S. L. Wilson, University of Alberta; Major Geo. A. Walkem, Vancouver Machinery Depot, Vancouver.

President's Address

Mr. Fairbairn, the retiring president, then made his presinential address, Reviewing the past year Mr. Fairbairn said it had been a serious one for engneers, with the reaction from the feverish war activity, but he hoped the turning point had about been reached. There must be for some time yet a downward trend in the prices of commodities, which in turn lead to greater demand for manufactured goods, which would put industrial life on its way to normal expansion.

This depression with its consequent unemployment of engineers, had been practically hard on the younger members, and a matter of grave concern to even the more firmly established engineers, although every effort had been made to secure employment for them.

Already there were signs of improvement. Groups of labor were sensibly accepting a lower wage standard. as necessary to getting commodity prices back to a point where trade would revive. While these were as yet few, they indicated a trend of thought which should lead to better things, leading to greater employment both for skilled labor and engineers. In such a productive country as Canada it was impossible for this depression period to last long, and he advised all to carry on, confident that better days were coming.

As to the institute itself. Mr.Fairbairn spoke with enthusiasm of the progress during the past year, the 22 branches now established throughout the Dominion having done splendid progressive work, while several new branches had been formed during the year, with others in prospect.

On Wednesday, January 25, the delegates to the convention visited the plant of the Dominion Engineering Works Ltd., at Rockfield, where they inspected some of the large turbines, valves and pumps being constructed by that firm.

C. H. Mitchell, vice-president

In the afternoon, Mr. J. C. Smith, vice-president and general manager of the Shawinigan Water & Power Company gave an illustrated address on the 41,000 h.p. unit now being installed at Shawinigan Falls. In the evening, Major Draper, of the Canadian Pacific Railway, gave an address on the construction of the new St. John Cantilever bridge.

Standardization of Building Codes

The Associated General Contractors of America Draw Up a Suggested Outline for a Civic Building By-Law that Aims to Simplify and Unify the Requirements.

At the recent annual conference of the Associated General Contractors of America, the Committee on Codes outlined the work it was doing in drafting a standard building code. The following suggested outline for a code was a part of that committee's report and was furnished to Mr. Herbert Hoover, the U. S. Secretary of Commerce, for consideration by the Committee on Revision of Building Codes, appointed by him and composed of representatives of various organizations interested in the work.

Outline for Building Code

1. Scope. The code should be prefaced by a statement as to its applicability.

(a) As to time: It should include all future work and may be in certain respects retroactive.

(b) As to character: It should include all permanent buildings, fences and billboards, etc., and not only the finished structures but also during the period of erection.

(c) As to extent: Definition should be made as to how much (if any) alteration may be made to any present building or structure without bringing it under the scope of the code.

The main portion of the code falls under three heads—

REQUIREMENTS, giving the information necessary to make the general plans for any specific building.

CONSTRUCTION, giving the information necessary to make the working drawings for all buildings.

ADMINISTRATION, giving the methods by which the code is enforced.

Part 1—Requirements

Requirements as to Occupancy—As practically all buildings are erected for a certain definite character of occupancy, such as residence, theatre, storehouse, factory, etc., the code proper should commence with a statement of its general requirements for buildings of every class, leaving the details thereof to be explained in subsequent sections. In order to avoid confusion, the names used to describe occupancy should be defined exactly and exhaustively; for instance, the line of demarcation should be carefully drawn between tenement houses, apartment houses and hotels, between loft building, factories and stores, between churches, lecture halls and theatres. Care should be taken to define the status of buildings whose occupancy does not fall in any well-defined category such as bath-houses, jails, railway stations. Provision must be inserted to cover buildings of more than one character of occupancy, such as retail stores with apartments in the upper stories, etc. The requirements as to occupancy fall under the following heads.

(a) Location

Limitations on occupancy may be imposed in the various zones of the city; thus factories may be excluded from certain neighborhoods, and those causing unpleasant odors or noises may be restricted to a zone of their own.

(b) Types of Construction

Different occupancies require different types of construction for exterior walls, floor, roofs, partitions and stairs. The usual method of prescribing types of construction in existing building codes is to group buildings as a whole into four or five classes, such as fireproof, ordinary, and frame. For comparatively few classes of occupancy does a building run true to type, so that the general definition for each type of construction is loaded with exceptions. It is therefore suggested that a simpler and more exact method is to define four or five types of construction for exterior walls, partitions, interior columns, floors, roofs and stairs separately and to prescribe for each class of occupancy which type shall be used. It should be noted, however, that very frequently more than one type of wall or floor, for instance, may be prescribed for the same building; thus, an occupancy allowing ordinary frame partitions between the rooms may yet require fire-proof or fire-resistive partitions around the stairway and elevator shaft. It should also be noted that the type of construction required by the occupancy may be modified by other considerations such as the height or location of the building, as provided in Section 3, b.

(c) Allowable Loading of Floors

Most codes specify certain loads for which floors or different occupancies are to be designed, these figures to be used for joists, girders or columns. For buildings where the whole floor may be loaded uniformly, this is necessary. However, in residences a row of bookcases and in offices a safe may load heavily one or two beams but there is no likelihood of the whole floor being so loaded. For such occupancies it is therefore recommended that the girders be calculated for a much lighter load than the joists. Allowance should be made for vibration in cases of floors used for dancing, marching or machinery.

(d) Safety Provisions

I. Miscellaneous arrangements of plan: such as limitation of area of space between fire-walls, etc., provision for rest rooms for women in factories and the location of workshops and property rooms in theatres.

II. Means of egress: number and size of doors, and when they should open outward; width and slope of aisles in churches and theatres; stairs, their number, width and steepness; fire-escapes, their number and location (details of construction to be given later). This section should provide for exits to roof, and from sidewalk vaults and from yards or light-wells.

III. Fire-fighting appliances: such as sprinkler systems, standpipes with hose reels and chemical extinguishers—when required.

(e) Light and Air

I. Dark rooms; the uses to which they may be put should be given, both when the rooms are and are not provided with a specified amount of indirect ventilation. (In this connection, the word room should be defined so as to prevent evasion of the code by construction of unauthorized alcoves, etc.)

II. Size of windows: the size of window and the amount thereof to be capable of opening for ventilation should be given for such occupancies as sleeping rooms, workrooms and places of public assembly, preferably in terms of the size of the room. Where indirect ventilation is permitted instead of windows, its amount and character should be given.

III. Cubic capacity: the number of cubic feet required per person in places of public assembly and in workrooms should be given—the latter will vary with different industries. A minimum size should be specified for sleeping rooms.

IV. Size of light shafts: for buildings on interior lots (or positions of corner lots more than a certain distance from the corner) whose rooms require windows, the amount of lot to remain open to the sky above the second storey window sills should be stated. This should increase as the height of the building increases.

(f) Sanitary Provisions

I. Water supply: when to be furnished and number of wash basins required. Hot water to be furnished in certain factories.

II. Water-closets: when to be installed and ratio of number required to number of occupants.

III. Use of cellars: how permitted; (line must be drawn between cellar and basement.)

3. Requirements Other Than Those From Occupancy—This subject should occupy the next chapter of the code. It divides itself into the following headings.

(a) Restrictions on Height

This is usually determined by the zone in which the building is located or by the width of the street on which it fronts. It should be given in feet rather than in stories and should be calculated from the top of curb (average curb if street is on a grade) to top of the front wall. Height of pent houses and roof structures should be governed by a line sloping back from the top of the front wall at a given angle.

(b) Restrictions on Types of Construction

These may be determined by the zone in which the building is located, or by the exposure (i.e., the width of the street on which it faces or its distance from other buildings) or by the height of the building.

(c) Projections over Building Line

I. Cornices, string courses, balconies, bay-windows, porticos, marquees, steps and areaways: the projection of steps and areaways, if allowed, is usually given as a percentage of the width of the sidewalk. Porticos are usually restricted to a percentage of the frontage of the building. Marquees may usually project to the curb, but must be a given height above the sidewalk. Continuous string-course, balconies or cornices (except the main cornice) are usually allowed to project a foot or two. The projection of main cornices should be governed by the height of the building and the width of the sidewalk. Isolated balconies may project several feet but should not cover more than a given percentage of the frontage. Provision should be made to collect rain water falling on roofs, cornices, marquees and balconies, and to dispose of it so that it will not be discharged upon the sidewalk. It is also suggested that the upper surface of window sills and string course be so sloped as to prevent the accumulation of snow or the standing thereon of articles liable to fall upon passers-by.

II. Projections under the sidewalk: If the street is likely to be occupied by a subway, the projection of foundations beyond the building line should be prohibited. The space below the sidewalk may usually be occupied by a vault, but if this is permitted it should be by revocable license. It is not uncommon to reserve a given space between the curb line and the outer side of the vault for pipes and conduits.

III. Party walls: their construction should only be permitted where, by mutual agreement between adjoining owners, they become an easement and their demolition is not allowed except by mutual consent; but the channeling of such a wall for columns should be permitted. A minimum distance between the party line and the ends of the beams resting on such a wall should be prescribed. The method of strengthening such walls by underpinning and addition of extra thickness should be given in detail.

IV. Carrying up chimneys: where a new building is built contiguous to and higher than a wall in which there are flues, it is usual to require that those flues be carried up to the level of the new building by the owner of the latter, at his own expense.

Part II—Construction

4. Structural Design. The necessary data are:—

(a) The loading for which floors must be calculated. These have already been given, but in tall buildings where the live load is comparatively small and shifting, however, it is usual to neglect a portion or all of it in designing the foundations and the columns of the lower stories.

(b) Roof loading and wind pressure.

(c) Allowable bearing on soils.

(d) Allowable stresses on materials.

(e) Formulae to be used.

5. Details of Construction. This section should prescribe those features which it is not possible to obtain by calculation, but which experience has shown to be necessary. They are best segregated into portions of the building thus:

(a) Foundations.

Protection of steel against corrosion, details of caisson construction, types of concrete or composite piles.

(b) Walls and partitions.

Minimum thicknesses, combination of different materials, skeleton and cage construction, bonding, hollow walls, recesses and chases, arches, parapets, fire-stops in studding.

(c) Floors.

Bearing of beams, beveling of ends of joists, bedding of sleepers, provision against dry rot, framing around chimneys and hearths, provision for disposal of water from fire hose (scuppers).

(d) Roofs. Guards on skylights.

(dd) Towers, turrets and spires.

(e) Stairs. Height of hand rail.

(f) Chimneys and fireplaces.

(g) Installation of heating apparatus.

(h) Plumbing and drainage regulations.

(i) Installation of electric wiring and apparatus.

(j) Elevators and dumbwaiters and their enclosures.

(k) Gasoline storage tanks.

(l) Theatre curtains.

(m) Flagpoles.

(n) Roof signs.

(o) Fences.

(p) Parade stands.

6. Specifications of Materials and Workmanship. This section should follow the lines of an architect's specification, but prescribing only those features necessary for safety and security.

(a) Masonry.

Quality of brick, stone, terra cotta, cement, sand, etc. Method of mixture of mortar and concrete. Quality of reinforcing steel and method of placing. Location of points for stoppage of work and expansion joints.

(b) Steelwork and cast iron.

Quality of materials, detail of connections, protection against corrosion.

(c) Carpentry.

Quality of material, method of framing.

7. Methods of Construction. This section refers to the processes to be followed during the actual erection of the building.

(a) Shoring and underpinning.

Shoring of sides of excavation and of walls of adjoining buildings. Underpinning walls to deepen foundation.

(b) Concrete forms.

Method of making and removing. Length of time to be allowed for setting of concrete.

(c) Protection of passers-by.

Sidewalk platforms.

(d) Protection of workmen.

Guards at elevators, construction of scaffolds.

(e) Demolition of buildings.

(f) Temporary safeguards for unsafe buildings.

Part III—Administration

8. Enforcement of the Provisions of the Code—This should be placed in the hands of a superintendent of buildings, who should be appointed for a long period, say ten years, subject to removal only for cause, and who should have the necessary assistants of his own selection to enable him to execute the following duties and powers:

(a) Interpretation of code.

He should issue regulations interpretative of the code; if necessary, establish tests to be used to determine the qualities of material and conduct tests of new materials. He should have the right to decide if and when materials and forms of construction not covered by the code should be used.

(b) Permits to construct.

No construction should be started without a permit, to be issued after the plans and specifications have been examined to determine whether they fully comply with the code. Applications for permits should bear the consent of the owner.

(c) Inspection of work.

Provision should be made for frequent inspection during construction and means provided to rebuild work done in violation of the code and to immediately correct any condition which is dangerous.

(d) Certificates of occupancy.

No building should be occupied until a final inspection is made and a certificate issued to show that the building complies with the provisions of the code and is considered thereby suited for the purpose for which it is intended. This certificate should be required to be kept in evidence, and no change in occupancy permitted without the necessary alterations and a new certificate.

(e) Building surveys.

Provision should be made for periodic inspection of completed buildings to see that they are safe and suitable for the purpose for which they are being used. Powers should be granted to cause corrections of any faulty condition, immediately, if necessary. A fund should be provided for emergency work of this character.

(f) Procedure in case of disaster.

It should be the duty of the police to summon a representative of the superintendent of buildings in cases of collapse of buildings and all rescue or demolition work should be under his direction.

(g) Appeals.

Right of appeal should be granted from the decisions of plan examiners or inspectors to the superintendent and from his decisions to a board of architects, engineers and builders.

Building Progress in Victoria

Upward Trend in Number and Value of Buildings Erected in Vancouver Island Municipalities.

By J. B. HOLDCROFT

Consulting Engineer, Victoria, B. C.

A marked upward trend, both in the number and value of the buildings erected in Victoria, B. C., and the surrounding municipalities has been noticeable during the last three years, although the total for Victoria itself shows a drop for 1921 of over $200,000 as compared with 1920. Presented in tabular form, the figures are as follows, showing number of permits against estimated values.

	1921		1920		1919	
Victoria	389	$977,162	304	$1,207,572	317	$526,141
S. Saanich	525	370,332	158	206,242	149	169,615
Esquimalt	37	85,505	26	29,608		
Oak Bay	107	254,488	41	197,465		
Totals	1058	$1,687,487	529	$1,640,887		$695,756

It will be noticed that there is a steady growth in the number of permits issued in all municipalities, and in the case of one, South Saanich, a very marked increase for the year just past. The increase has been almost entirely in residential construction, which is an encouraging sign, as houses are badly needed and work of this nature employs a relatively greater number of men than the buildings such as stores and offices etc., which quickly build up an impressive total of money expended.

There were, however, a number of quite large jobs undertaken both in 1920 and 1921 which point to definite progress. Among others the following are of interest:—

1920		1921	
Capitol theatre	$200,000	Hospital	$170,094
Hudson Bay store	270,000	C. N. R. Office	12,000
H. F. Bullen residence	40,000	Gas Works	125,000
C. N. R. roundhouse	39,500	Bank	45,500
Office building	67,000	Oil Storage	10,000
Mfg. Plant	40,000		

In each of these years there were in addition to the items listed here a number of garage buildings erected which varied in cost from $8,000 to $11,000. All this goes to show that in spite of the depression in business and the unemployment existing, there is real activity and a rising curve of construction.

Co-operation in Highway Building

All of the Interests Involved in Road Development Should Work Together—Better Workmanship and Greater Standardization Will Result from Correlated Efforts

By **WM. ORD**
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Before American Good Roads Congress

Co-operation is a word that has grown to have a very large meaning in all walks of life in recent years. Formerly "might was right," but now "the greatest good for the greatest number" is the foundation of most successful institutions. This is secured by co-operation, by all interests working together for a common benefit; and is in contrast to the principle of "every man for himself, and the devil take the hindmost."

Wherever co-operation has been intelligently and faithfullly tried, wherever an immediate, selfish, interest has given way to a larger, more common interest, it has been proven good. It takes time for the benefits of co-operation to become fully manifest, but in the long run it always pays. This has proven true also in social affairs and in, what is more to our point, business.

It is not necessary to discuss at length the merits of co-operation as a general principle. Books have been written about it, telling how co-operation has worked. Is is necessary for us road builders all to get together to see how we may use it for the benefit of our industry as a whole, as well as for the benefit of our members individually.

If we are to study this proposition we may start by asking three questions:

1st.—Who are definitely the parties we expect to co-operate?

2nd.—What benefits are we to seek, or may we expect, from proper co-operation?

3rd.—How are we going to promote co-operation, not only to get over the idea, but to get constructive action?

Ten Interests Involved in Road Work

Let me briefly try to outline the answers as I see them now, after a very limited amount of personal observation. There are, I believe, ten parties, or interests, who all have more or less to do directly with every road that is built. They are:

1st.—The people as a whole, including the taxpayers who buy the roads, and the vehicle owners who use them.

2nd.—The legislators who make the laws governing the financing, construction, and use of the roads.

3rd.—The engineers of our highway departments who locate and design the roads, who superintend their construction, and later are charged with their maintenance.

4th.—The contractors, who perform the actual construction work.

5th.—The manufacturers and producers who supply the necessary materials which may not be produced locally by the contractor.

6th.—The other manufacturers, who furnish the tools and machinery.

7th.—The railroads, who provide the transportation of materials, plant, and men.

8th.—The bankers, who handle the moneys passing among all the other parties.

9th.—The bonding companies.

10th.—Labor.

The trade press is, of course, to be considered a factor in the industry. The work it does is highly important in bringing all the other ten parties closer together, and in the analyses it makes of the problems of each. It is not however directly responsible for any part in the construction of any one road, and it is proper, I belive, to omit it from the list given.

Great Developments in Road Building

Our industry, at least in its present magnitude, is so new that all its problems have been difficult to classify, to say nothing of the difficulty of their solution. The war served to complicate many issues that would have been easy to analyze in normal times. It may be said, however, that each of the ten parties mentioned above has made great and important progress in its own particular branch of the business. There has been a development of uniformity in road laws. Designs and specifications are clearly becoming more standardized. Contractors have so improved their methods that their individual outputs per annum have greatly increased, and considerable has been accomplished towards reducing costs and improving quality.

Means of using satisfactorily materials formerly considered of inferior quality are being found by the material producers collaborating with the engineers. Machinery has been revolutionized; and we have found improvement in matters of finance, bonds, transportation, and in the training, working, and care of labor. All the progress that has been made is, however, probably infinitely small in measure when compared with what we still have to do.

It is to be noted that practically all branches of our industry have been organized for co-operation among the members of each branch. The people have their good roads associations, automobile clubs, and chambers of commerce with good road committees. The thinking of our lawmakers is being headed up and a national view of good road subjects is more generally being taken. Our highway engineers, contractors, machinery and material people, and also the railroads, banks, and bonding houses, are all associated with others of their kind. Finally, labor has its unions.

The work these associations have done has been of remarkable benefit to the industry as well as to the members of those associations. There is no need to go into detail. We all understand to some extent how they are functioning and the progress they are making. We know, for instance, how much brick, cement, and asphalt associations have helped solve hard surface problems by their investigations, how the contractors' associations have stabilized contracting by co-operating with engineers to improve contracts, and how the auto clubs have helped to broaden the demand for good roads.

Co-operative Efforts

It is more significant, however, to note how the various associations are beginning to work together and how they are beginning to be interested more and more in each other's problems. Last month there was a highway construction conference in Harrisburg, Penna., in conjunction with the annual meeting of the Associated Pennsylvania Highway Contractors. Persons from all branches of the industry were invited and many of them gave talks. Lower freight rates on materials, costs of bonds, relations of contractors with bankers, the cement market, and many other such subjects, each affecting several different interests, and demanding co-operation, were discussed. A resolution was passed urging a greater degree of standardization in machinery, and suggesting conferences between the contractors and the machinery manufacturers. The spirit of co-operation dominated the whole meeting.

A very pretty illustration of what co-operation can accomplish was given a year or two ago when it was pointed out, first, I believe, by Mr. MacDonald of the Office of Public Roads, that in the winter time the railroads have an excess of open top cars and a shortage of them in the summer. Everybody interested took hold of this idea with the result that the highway engineers are awarding their contracts earlier, so the contractor can arrange for winter shipping and storage of materials. Laws were passed in many districts providing for partial payments on materials so stored. The railroads were benefited. The season of the sand, gravel and stone companies was lengthened, the contractor is able to do more work per annum and more work is assured to labor. In fact, it seems that this one action of awarding contracts early has affected our whole industry and all the ten interests in it.

We have had many other very interesting examples of co-operation between our branches in the past. The results have been gratifying and it has been most thoroughly demonstrated that willingness to co-operate exists everywhere. Co-operation has, however, been a sort of hit or miss proposition. Issues have been met only as they have arisen. Very little has been done to plan co-operation of all parties. It is perhaps because our industry is so large in volume and spread out so all over the country and has so many ramifications.

It has been difficult, if not impossible, for any one to grasp the entire problem. To me it is clearly indicated the work of co-operation must be planned by a committee of a national association such as the American Road Builders' Association.

Regardless, however, of what the Association may be able to do, it remains for the members to co-operate among themselves to a much greater extent than they have done in the past. Let us study each others problems, and especially the problems of those with whom each of us comes most frequently in contact. Every single member of any of the ten interests is as justly entitled to consideration as you are yourself. He represents one tenth of the list of active partners in building roads and is just as necessary to the industry as the representatives of any other interests.

In closing, let me state the "Law of Equal Reaction," which Babson, our foremost industrial statistician, has defined thus: "Every act of ours reacts to our own advantage or disadvantage, according to whether it helps or harms all parties affected. This means that our future prosperity depends on the amount and quality of service we render. We get what we give, and prosper as we serve."

Financial Conditions at Present Time

Much to be Encouraged About and Much to be Regarded Seriously—Business Will Improve This Year—Need for Initiative and Judgment

By HERBERT P. HOWELL
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The present business situation is distinctly a two-sided proposition. There is much in it to be encouraged about. There is also much to be regarded seriously. Either an optimist or a pessimist can cite plenty of facts to support his case. We have had many exponents of both schools making out plausible cases. One may study the situation and find grounds for declaring that no great financial problems remain to cause anxiety. The other may look at events from his point of view and find justification for his fears that grave difficulties still confront business.

Both are partly right. But I have no hesitation in asserting the conviction that the favorable factors outweigh unfavorable factors. We are not going to have another great and rapid revival of business such as the optimist might feel justified in hoping for. But we can unhesitatingly count on a continued gradual trend of developments toward more stable and more active business conditions.

Better Conditions for 1922

Business was in far better shape at the end of 1921 than at the beginning. It will be in better shape at the end of 1922 than it is now. In net results 1922 will be a better year than 1921. We might qualify this statement by saying 1922 will be better, provided business men as a whole continue to act sensibly. We might say that developments will be favorable if economy, conservation and efficiency rule in business, rather than efforts at stimulation and expansion.

But it is not necessary to make that qualification in words. It is inherent in the facts of the situation. Conditions are such that economy, conservatism and efficiency will prevail in business because the pressure of circumstance compels observance of these measures.

Business that tries to run ahead of the conservative progress of the times toward normal will be liable to disaster. Efforts to spread out will bring disappointment and failure. Lucky individuals may run ahead of the game for special reasons. But as a rule 1922 will be a good year for remembering above all that business is business and not speculation. During the boom, business had to speculate despite itself due to the rapid change of circumstances. Rising markets often made it unsafe not to go long of materials. Failure to expand under conditions then existing seemed like turning one's back on opportunity. But that is not true for 1922. Undue stimulation and expansion simply will not work this year. The market will not take them.

Profits can be made and success can be established during 1922. But they must be built up by means of economy and efficiency within the bounds of conservative business operations. A lower turnover is inevitable. There is a rigid price resistance from the ultimate consumer that must be accepted. Therefore, profit margins in business must be effected by economies in production costs.

There are definite reasons for the statement that the improvement in business during 1922 will be gradual. Enough favorable aspects are obvious in business to encourage confidence, but not to warrant any relaxation in vigilance and care.

Foremost among Favorable Factors in the general situation is the condition of banking. Fear need not be felt regarding the ability of worthy businesses to command adequate banking failities and at reasonable rates. The banking situation is strong because the underlying conditions upon which the structure rests have been strengthened. At the opening of the year 1921 bank credit was characterized by inflation, non-liquidity and widespread insecurity. During the course of the year there has been a material reduction of non-liquid and unsound credits. There has also been considerable reduction in the total volume of credit in keeping with the progress of liquidation, falling prices and reduced business activity.

The more healthy conditions in the investment money market make it possible for commercial banking to adhere to strictly commercial business. Investment funds are available for long time requirements. The banks are free to take care of current needs as is their function.

We can also feel that mercantile business is in far better shape at the end of the year than at the opening of 1921. There has been a widespread adjustment of inventory valuations. During the boom many ill-conceived businesses sprang up and flourished due to easy conditions for success. A horde of speculative middlemen came into being. The more rigid competitive conditions of the period of reaction have eliminated many of these various classes of business units. It has not been a pleasant process and while not complete, it has created a stronger mercantile business situation. It has also resulted in the removal of many obstacles to the establishment of fairer prices for the consumer.

Conditions in Industrial Business

In industrial business also conditions are sounder at the end of the year than at the beginning. The general inventory position has been improved. There has been a return to a greater degree of corporate economy. There has been, as a result of unemployement and competition for work, a development of greater man power efficiency. Wage reductions have contributed to the bringing down of production costs.

The price situation is also better. The period of avalanche price declines is over. This movement was still in progress at the opening of 1921. After a period of business activity for nearly twenty years with rising prices it was a new experience for business to have prices start downgrade. The present generation scarcely knew how to do business under such circumstances. Although many prices will continue to recede business and banking are now better schooled to cope with that situation. We need hardly fear a general price demoralization.

The attitude of the public in respect to buying is now a more calculable business factor. In the first place any thought that the public will buy at almost any price can be eliminated from business calculations. It can be set down as definite that the public has become thrifty and discriminating in buying. Decreased purchasing power and unemployment have made it so. People are willing to buy what they require so far as they are able and where they can find fair prices. A thrifty public, in the long run, is better for business than is an extravagant public.

Obstacles to Improvement

With all these facts of betterment, why should the decision not be rendered in favor of the optimist? Because on the other side of the picture there are certain serious elements of maladjustment that cannot be ignored. There are impediments to the healthy functioning of the markets and difficulties in the way of a complete readjustment of the costs of production and distribution. These obstacles must be overcome before anything like a fundamentally normal business situation can be re-established.

Among the obstacles to reducing the costs of production and distribution are certain classes of wages. Mining, transportation and building labor must be further re-adjusted. The effects of these still relatively high wages permeate all kinds of business. There can be no thoroughgoing completion of general re-adjustment until these sources of high production and distribution costs have been dealt with.

Similarly, on the cost of doing business, is the burden of taxation. The country's obligations must be met by taxes. Relief in this situation must be worked out through the difficult process of reducing current government expenditures and through shifting the burden of necessary taxation so as to reduce as much as possible its hampering effects upon productive enterprises. The new tax law and reduced aggregate tax levy are encouraging features.

Again on the cost side of business are the debts created by the extensive funding of current obligations following the boom. This has created interest and amortization charges against present and future earnings. Also, the burden of high overhead charges from extensive, over-built or idle plant equipment has to be reckoned with.

These various sources of special production and distributing costs add to the difficulties of doing business, of reducing prices, and therefore, to the slowness of recovery. While they are operative they must be met by economies in other directions. It can be said that never before in modern industrial history has there been such a pressing need for economy, never before such an imperative necessity to reduce wastes and increase efficiency.

Finally, on the cost side of business must be cited the high-priced inventories still to be reduced. Despite the general progress made in inventory re-adjustment, there are many lines yet carrying a heavy burden here. Impaired buying power made impossible in many cases the distribution of stocks at prices covering production costs. It seems inevitable that some further losses must be taken on this account. Here again there appears to be no alternative but to offset these losses by unusual economies in the total activities involved in handling such stocks.

Choppy Condition of Prices

On the marketing side of business we are confronted with a choppy condition of prices. Many prices have gone much further toward the pre-war basis than others. This has made impossible, for instance, the absorption by the agricultural communities of normal volumes of retail goods whose prices have not fallen to so great an extent as have prices for farm products.

Again, as to market conditions, although some pices have apparently reached comparatively stable levels and no general collapse is to be feared, nevertheless there are some prices where further changes are to be expected. This is true where excess stocks of raw products are overhanging the market because of over-production or impeded distribution. Further downward movements may be expected here. On the other hand, there are undoubtedly some prices which will be driven temporarily upward in cases where there has been too great a curtailment of production. As existing stocks are absorbed shortages may develop. In general, the price situation is characterized by a number of inconsistencies.

Finally, there is the effect of the situation in the world markets upon domestic industry and commerce. This country must have world markets. This is broadly true in respect to agricultural products. It is also true in respect to many of our manufacturing industries. Our consumption demands alone are not sufficient to absorb the total outputs of such productive interests at prices to keep them fully employed on a satisfactory basis. Excess production must be sold in the markets of the world. While the world markets are in their present demoralized condition, the marketing of such surpluses will be a problem.

We have the resources and are equipped to do a tremendous business, both in the domestic field and and in the foreign field. But the markets, both in the domestic field and the foreign field, are still greatly out of gear. Business cannot go ahead with the full swing of confidence and prosperity until these markets are brought back into gear.

In the foregoing I have attempted to picture the structural framework of the present business situation. It is obvious further drastic re-adjustments must be made. These re-adjustments, looked at in detail and detached from broad considerations, may seem in some instances to imply adverse effects upon one class in the community as distinguished from others. This is a narrow view to take of them. It is perhaps the natural human view. The human element in business is a factor to be considered as well as the foregoing more technical aspects.

Wage Re-adjustments

For instance, in the case of wage re-adjustments, there is nothing in that suggestion inimical to the interests of labor. Arbitrary money scales are obviously not the fundamental consideration in the best interests of the worker. Business activity, steady employment and maximum purchasing power of wages are really what give labor the standard of living it demands. In so far as reduced wages help restore business activity, bring about steady employment and reduce the cost of living, the interests of labor, business and the general public are absolutely identical. It is a hopeful sign of the times that most classes of labor have accepted this viewpoint.

Again, the requisite further reduction of retail prices may seem to imply a re-adjustment bearing more heavily upon one business element than another. But the case is not different in essentials from that of labor. What the retail business men obviously want are volume and steadiness in business. It is, generally speaking, immaterial to them what price levels prevail so long as there is a fair margin between selling and buying prices. As general living costs go down a narrower net profit gives just as much purchasing power as would a greater profit when general living costs were up.

Lower retail prices will benefit the public and benefit the merchant by stimulating his sales. It is an impulse for better business activity that will flow back to the ultimate sources of production. It will help in the clearing up of difficulties of all stages.

These instances of wage and price re-adjustments are cited to emphasize the community of interest that all elements have in the consummation of re-adjustment. The cases named are not different from others that might be mentioned.

It is not the carrying out of these movements that causes injustice. No business element can expect to see corrections in other phases of business and avoid a similar processs in respect to its own. No class in the community can expect to enjoy the benefits of deflation without sharing the burdens. Deflation, if it means anything, means a reduction of incomes as well as expenditures. It means a reduction of consumers' as well as producers' prices. It means a reduction of wages and salaries as well as profits and dividends. But it need not mean a reduction in general standards of living if these various reductions proceed to a state of equilibrium.

Conditions for Equilibrium

There can be no equilibrium if any element in the community by resisting re-adjustment seeks to establish higher real wages or higher purchasing power for the fruits of its efforts than are justified by economic relationship with other phases of industry, commerce and finance. Fortunately we can rely upon economic forces to go forward impartially. They are no respecters of persons. In the long run they will not permit any class, as a class, to intrench itself permanently, as a result of war and post-war conditions, in a more favored position than the intrinsic value of its services to the community as a whole warrants. The market will determine these values. The year that lies ahead, I am confident, will see a progressive smoothing out of the inequitable conditions now prevalent in business.

There perhaps has been a suggestion of business fatalism in what has been said. The outlook for the year, it may have seemingly been implied, is that business men will be subject to economic forces beyond their control. It has been said that economy, conservatism and efficiency will prevail because there is no alternative. It has also been said that economic forces will control the course of events.

I am no business fatalist. In the past, with recurrent eras of prosperity and depression, it has sometimes seemed as though business were subject to the coming and going of inexorable tides. In the present situation, too, the war set forces in motion that have seemed overwhelming. But I am confident that effective ways are being found to diminish these conditions.

Never before was there a greater demand for individual initiative in business, never before a greater need for penetrating judgment. Recognition of the larger principles controlling business conditions does not mean an admission of helplessness. These principles are guide-posts to sucess, not barriers to individual achievement. To say that the times require to an unusually high degree the practice of conservatism, economy and efficiency is only to say that they require the intensive application of the methods by which, in the long run, the lasting and substantial progress of the world has been built. The full fruits of brilliant pioneering enterprise, in whatever field of endeavor, would never have been harvested had not discovery been followed by hard work.

There has developed at the end of the year just closed a remarkably general consensus among those qualified to pass judgment on business conditions that the worst is over and better lies ahead. In this judgment I heartily concur. The year 1922 may not be one of great realizations and fulfillments, but it will be one of laying the strong foundations for better business years to come.

(The above analysis was presented by the author at the 18th annual convention of the National Dry Goods Association, held in New York on January 19th, 1922.)

Good Roads Congress

Twenty Thousand Attend Convention of the American Road Builders' Association at Chicago

That the good roads movement in the United States and Canada is running on high gear with an impetus that is developing the greatest road building era in all history, was demonstrated at the twelfth American Good Roads Congress and thirteenth National Good Roads Show held at the Coliseum in Chicago, January 16 to 20 last, under the auspices of the American Road Builders' Association.

With an attendance of approximately 20,000 and exhibits by 177 exhibitors of some $2,000,000 worth of road-building machinery, methods, materials, appliances and transportation equipment that overflowed the Coliseum and annex into two adjoining buildings, this great event proved to be the largest and most auspicious in the history of the Road Builders' organization. The technical papers and discussions surpassed in quality and instructive value those of any previous meeting, and the sales by exhibitors at the show are reported to have broken all records.

Important action on a number of questions was taken. Among other things the resolutions pledged the support of the American Road Builders' Association to the elimination of advertising signs, grade crossings and interurban tracks from the highways; and condemned the attitude of negation displayed by railroad companies and railroad commissions on the subject of grade crossings. Other resolutions pledged the association to work for efficiency and permanency in the personnel of all highway departments, and the elimination of partisan politics from highway construction. The Congress also went on record as favoring a pavement width of not less than 20 feet for all trunk highways or roads carrying dense traffic. Hearty endorsement was given to the efforts being made by various committees to find a method of stabilizing subgrades and of ascertaining the relationship to traffic and road surfaces.

The Value of Good Transportation.

In opening the Congress, President H. L. Bowlby, predicted that the present generation will see the time when the continent will have the finest and most extensive system of arterial and tributary highways the world has ever known.

"Good transportation facilities," he said, "constitnte one of the greatest sources of a nation's wealth. We of this generation do not have to search the pages of history to appreciate the vital part that highways have played in national development. The passenger automobile and the motor truck industries which, combined, now rank third, both in the capital invested and in the value of output, are absolutely dependent for their stability and growth upon good roads. The expansion of our agricultural production is largely a question of good roads. This is true also of practically every phase of our industrial development. The highways are the arteries of trade and through them flows the blood which gives to the nation its commercial life. It is the arteries that band the communities together, foster the greater community spirit, develop the national unity and weld the people into a cohesive whole."

Discussing the subject "Uniform Legislation as Affecting Highway Traffic", D. C. Fenner of the International Motor Company, New York, declared that uniform legislation does not mean necessarily that all states or provinces should adopt one and the same law, identical in all their provisions. "This" he said, "might be considered the ideal condition, but from a practical standpoint, it is not necessary. What is needed, however, is uniformity in those sections of the laws that deal with definition of terms, traffic regulations, hand signals, qualifications for drivers, size and weight restrictions, obligatory equipment of a vehicle, head-light laws and the determination and disposition of license fees."

In discussing "The Business of the Highway Commission", C. M. Upham, state highway engineer for North Carolina, laid stress upon the matter of rendering to the public an accurate account of all expenditures. "The highway commission," he said, "must be able to show the actual cost of construction of all roads and must surely show the cost of maintenance per mile per year for every piece of state highway. There are many detailed problems arising, such as the purchase of materials and equipment, but each of these questions must be handled as it would be done by an individual or corporation. It is its further business to see that the highways are at all times economically maintained in their highest degree of excellence."

How Eliminate Waste?

Low, Interrupted, Restricted and Lost Production Largely Responsible for Waste in the Building Industry

By J. PARKE CHANNING

Before Associated General Contractors of America.

In assigning the relative responsibility for waste, 50% of this responsibility has been placed at the door of management and less than 25% at the door of labor. In assessing this responsibility there has been no purpose or desire to place blame upon any individual, group or class. Waste, like industry itself, is the result of a slow growth but undoubtedly the greatest opportunity today for correcting it is the hands of management. By management is meant all of those engaged in industry from foremen up to the financial heads of the concern.

The causes of waste may be classified under the heads of low production, interrupted production, restricted production and lost production. Low production is caused by faulty material control, faulty design control, faulty production control, lack of cost control, lack of research, faulty labor control, ineffective workmanship and faulty sales policies. Interrupted production is caused by idle men, idle material and idle plants. Restricted production comes about either by restrictions of the owners of management or by labor. Lost production is largely due to ill health, physical defects and accidents.

The recent conference on unemployment makes suggestions toward correcting interrupted production due to idle men. Probably of all things this is the most vital. It is unfortunate that in a country like ours we should have idle men when we have such rich resources and such demands for finished goods. A large portion of this unemployment is due to booms and depressions, and while we do not thoroughly understand the causes of these cycles, we are getting nearer and nearer to the truth, and I believe that we can look forward to a time when the peaks and valleys will be nearly leveled out.

The one thing, to my mind, that stands in the way is a psychological one, and that is when we are in a boom period we fail to realize it, imagine conditions are normal and that the real boom is ahead of us. It is only a few far-sighted and sound-thinking men who realize the actual condition. It is incumbent upon owners and managers to study this question thoroughly to see that information is collected and distributed and to properly interpret it.

Proper Industrial Relations.

I believe that proper industrial relations is one of the most important factors in stabilizing industry. Professor John R. Commons, of the University of Wisconsin, has very properly said if all managers and owners treated their men fairly there would be no need of labor unions, but because owners and managers have not followed the Golden Rule the laborers have been forced to organize for their own protection. I believe that in well stabilized industries where the changes in personnel are at a mimimum there is less friction between management and labor. In industries of this class men get to know the management and the management to know the men. Their peculiarities and individualities, their capacities for particular kinds of work are realized and the results are generally good.

One reason that there is so much waste in the building industry and so many restrictions on the part of labor is the constantly charging personnel. Following along this line, you will note that the Committee assesses 25% of preventable waste as against outside contracts; for example, the public. And this means that the public itself must be educated to the necessity of a smooth and regular operation of industry and must not demand the impossible and must realize that everyone cannot have his wants filled at the same time.

In adopting a program of seasonal construction in different geographic divisions of the country, I, of course, realize that there is a serious problem in attempting to move labor from one part of the country to the other. A competent mechanic usually has his home in some town and dislikes to move from place to place, but there is a possibility that a certain proportion of the men, particularly those unmarried, may follow this plan.

Among the things which the Committee recommended is proper production control so that material always will be on hand and delivered when needed; that the plant and equipment should be kept continually in working order; that one should have a uniform system of cost accounting and particularly that the methods of wage payment should be equitable and just in pursuing the proper relationship between the efforts put forth and results achieved by all who participate in the enterprise. All of these recommendations seem perfectly obvious but it is astonishing the number of instances in which they are neglected.

Especial attention was called to the fact that wage methods are wholly futile in the absence of standardization and system in the work. In a great many cases, proper production standards and proper control of the work will, without any special wage method, accomplish a large part of the desired result.

Management is also responsible for the prevention of accidents in industry and a "safety first" campaign not only has its humanitarian effect but results in an actual saving in dollars and cents. This, of course, is recognized in the various workmen's compensation acts in which the cost of death and accidents is directly paid by the industry and becomes one of its charges. The lower this charge, the less will be the cost of production.

A Tremendous Fallacy.

Among the responsibilities of labor is that of increasing production. Among the unenlightened, the idea that there is a fixed amount of work to be done in the country, and that the less a man does the longer the work lasts and the more men are employed, is, of course, an economic fallacy but is held by a great many men. There never was a greater fallacy than this, and I am glad to say that the best minds in labor circles realize its fallaciousness. Still, it must not be forgotten that labor has had many sad experiences in the last eighty years in which the result of increased effort, both mental and physical, has not been rewarded as it should be but has been entirely appropriated by capital.

The government can give aid in the elimination of waste, and the most important thing is the establishment of a national industrial information service, so as to furnish accurate and timely information on production, consumption and stocks of commodities. In addition, I believe that the government can help with its employment service.

Mainly Constructional

East and West—From Coast to Coast

Messrs. Byrne Bros., heating and sanitary engineers are opening an office and show room at 465 Bloor St. W. Toronto.

Building permits issued by the building department of York township Ont., during January amounted to $360,000. or more than double the total value of the permits for January, 1921.

Plans are being made for an early start on the new water works system at Port Credit, Ont., in an effort to have the new plant in operation by next fall. The new system is estimated to cost $110,000—$60,000 for the central plant and $50,000 for the distribution system.

The Fraser Brace Company, of Montreal, will shortly commence construction work on four ships at the Three Rivers shipyard plant, these ships to be completed by September 1 next.

The amount represented by permits issued by the city architect's department at Toronto during January is about 100 per cent. more than for the same month last year. The figures are, $1,100,000 for January this year as compared with $568,000 issued in January last year.

The P. H. Secord Construction Company of Brantford, Ont., has started work on the Dunsmore Road School Hamilton, which will be the largest in the city. It will have 44 class-rooms and will be ready for occupation in January, 1923. There will be an auditorium with a seating capacity of 1,200.

A recent report from Montreal states that a new ice arena is planned, to be erected at the corner of St. Luke St. and Atwater Ave. The structure planned will be of fireproof construction, will cost $400,000 and accommodate 6,000 people. Construction work will be completed by September 1, this year.

The report of Mr. W. W. Worsfold, Dominion government engineer, investigating the wrecking of the Capilano Bridge in British Columbia by floods, several months ago, exonerates the two local engineers who were responsible for the design of the bridge, from any blame in connection with its failure.

Major Plant of Ottawa officiated at the recent opening of the Cummings Bridge, over the Rideau River, in that city. This structure is the second largest concrete bridge in Ontario, being 620 ft. long, composed of five river spans and two approach arches. The bridge, when all remaining detail work has been completed, will have cost $425,000. Mr. Thomas McLaughlin was the contractor.

The T. R. Nickson Construction Company, of Vancouver, it is announced, has secured the contract for the reconstruction of the city's wrecked 25 in. pipe line across the third and fourth breaks, that is, the two upper breaks, and will install a temporary connection with the lake by means of the 14 in. main. This work will give employment to between 75 and 100 men.

The sixteenth annual convention of the Alberta Association of Architects was held recently at Edmonton. The association was in session for two days, the meeting being brought to a close with the annual dinner in the Macdonald Hotel, at which several prominent men, including Lieut.-Gov. Brett, Major D. M. Duggan of Edmonton, Commissioner C. J. Yorath and professors R. S. L. Wilson and T. Robb of the University of Alberta, were present.

Mr. R. C. Harris, Works Commissioner of Toronto, recently submitted to the Works Committee his proposed program of civic works improvements and maintenance for 1922, which entailed an estimated expenditure of $10,462,769. The Committee, however, by rigid pruning, has reduced this amount to $5,162,769, and have submitted the program to the council.

Personal

Mr. L. E. Shaw, president of the firm of L. E. Shaw, Limited, manufacturers of brick, at Avonport, N. S., left recently for a business tour of Pennsylvania. Mr. Shaw will investigate brick manufacturing methods and plant management in this state.

Mr. C. E. Fraser, formerly of the Toronto engineering firm of James, Proctor & Redfern, was recently appointed road superintendent of Scarboro Township, Ont. The council is planning extensive road building and improvements this year and decided on the establishing of the office of road superintendent, so that this work will be carried out under careful supervision.

Mr. Arthur St. Laurent, assistant deputy minister of public works, at Ottawa, has been appointed chief engineer of the department, succeding the late Mr. E. D. Lafleur.

Mr. J. Emile Vanier, civil engineer of Montreal, recently returned from a two months' trip to Europe, where he engaged in extensive investigations into the use of limestone dust for fertilizing purposes. Mr. Vanier is preparing a report of his findings for submission to the Quebec Provincial Government.

Major Robert McKnight was recently appointed engineer of Grey County, Ont., being selected from a field of about a dozen applicants.

Dr. W. H. Sutherland, member for Revelstoke, B. C., succeeds Hon. J. H. King, as Minister of Public Works of British Columbia. Hon. Mr. King has gone to Ottawa to take over his new appointment as Minister of Public Works in the Federal Cabinet.

Dr. Milton Lewis Hersey and Mr. Emilien Daoust are the two new members appointed, in conjunction with Dr. W. L. McDougal, to form the reorganized Montreal Harbor Commission. The latter gentleman is, as announced in a recent issue, chairman of the new commission.

Obituary

Mr. George Hancock Sr., contractor of Galt, Ont., died in that city in his 69th year. Deceased was born in Sheffield, Eng., coming to Canada 52 years ago and taking up residence in Galt.

Mr W. B. Simes, managing director of the Dominion Plumbing Co., died recently at his home in Port Arthur, Ont., in his 39th year. Deceased was born in Ayrshire, Scotland, coming to Port Arthur 17 years ago.

Mr .C. Howard Ellis, prominent Toronto architect, died at his home in that city recently, after a long illness. Deceased was born in Meaford 37 years ago, and, after studying in Toronto, New York and abroad, entered into a partnership with his father at Toronto, under the firm name of Ellis & Ellis.

Trade Incorporations

French Brothers, Limited, with head office at Toronto, capital $50,000, to carry on the business of building contractors.

J. E. Lancaster Construction Co. Ltd., with head office at Montreal, capital $50,000, to carry on the business of contractors and builders.

The Fairbank Block & Supply Co. Ltd., with head office at Toronto, capital $40,000, to carry on the business of contractors and dealers in cement, roofing materials, etc.

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New House Building Venture in Toronto

Something new in the way of providing homes for those who, up to the present, have been unable to finance the building of their own homes has come to light in Toronto recently through the announced operations of the Provincial Home Builders, Limited whose head office is located at 88 Bay street. W. H. Alderson, past president of the Toronto Board of Trade, is president of the new company.

The firm's intention is to inaugurate a plan whereby a lot owner may erect a home on his property through an easy-payment scheme. The plan is equally applicable to those who may not own property in which case the company assist the customer to secure the land desired. By this plan a customer will subscribe to an agreement whereby he will apply for membership in a unit of 100. The sales organization expects to secure this number of applicants in each three week's period. As each unit is closed, a home will be started and the one who has the largest amount to his credit will be allotted the home.

The payments are as low as $5 weekly but the average payment is expected to be twice that figure. Where the plan has been worked out, in Chicago and Montreal, it has been found that many applicants were able to deposit considerable amounts to their credit at the very beginning. This hastens the erection of the houses.

In the scheme, every precaution is taken to guard the interest of the members as well as the company. For instance, the applicant's life is insured, if he is an insurable risk, and in the event of his death, his heirs do not have to make further payments on the second mortgage, the insurance providing for that emergency.

Even though only the regular weekly payments of $10 are paid in, the period required to retire the mortgages would be considerably less than is usually the case in the individual way of buying. Further, there are no interest charges on the payments to the company. One of the direct benefits to the purchaser, it is claimed, is the fact that the home which he is able to buy through this plan would cost considerably more if bought in the ordinary way. There is a saving of approximately 20 per cent. right away, owing to "quantity buying" on the part of the company.

The erection of 1,500 homes by this plan is suggested for this season.

Stabilization of Private Industry Through Public Works

By O. T. Mallory, before the Associated General Contractors

The business world has long regarded depression as an extraordinary accident—a sudden stroke of paralysis for which there is no remedy except patience and hope. Another conception is revealed by a study of the last hundred years of industrial history. These apparent extraordinary accidents are seen to be events recurring with some regularity every seven to ten years. After a depression there is a gradual rise, becoming more rapid as the crest of the wave is reached. At the crest there is a scramble for labor and materials, prices and wages soar, and credit is over-strained. When the wave breaks, the higher the wave the greater and the longer and the more severe the subsequent depression and unemployment. These periods of depression seem to be speeding up in accordance with the acceleration of modern life. They occur more frequently than fifty years ago.

As depressions are getting more frequent and more acute, methods must be found for preventing or mitigating them, else our complex business structure cannot survive.

Two important methods are proposed by competent business men and engineers. The first is the outgrowth of the study of waste in industry conducted by the Federated Societies of Engineers under the leadership of Mr. Hoover. These studies point out certain practical steps in the elimination of waste and have led to further study of the specific industries, now being conducted under Mr. Hoover's direction.

The second method is a recommendation of the U. S. President's Conference on Unemployment, embodied in the Kenyon bill. This bill provides that public works be postponed when private industry is competing for the same men and materials and the accumulation executed during periods of industrial depression. Everyone admits this to be a wise plan. The only question is how to accomplish it and how large will be the results. The Kenyon bill is no panacea, but provides for a few of the first steps. The federal government's chief public works are rivers and harbors, public buildings, reclamation, and federal aid to roads. The Kenyon bill proposes that advance engineering plans for all such work be kept ready so that an appropriation at any time would result in immediate execution during a period of de

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Canada's Engineers—Theo. Lanctot

Mr. Theo. Lanctot, who was recently appointed city engineer of Hull, Que., was born in Montreal, and after attending primary school in that city entered the Mont St. Louis College, from which he graduated in 1902. Upon leaving that institution Mr. Lanctot joined the Canadian Pacific Railway Company, with which company he remained for the two following years, 1903 and 1904, during which period he came to the conclusion that a University training was quite necessary to the practice of engineering. He then began in 1904 a four-year course at the Montreal Polytechnique Institute, where he obtained in 1908 the degree of B. A. Sc. and the diploma of graduate civil engineer.

Upon leaving the university, Mr. Lanctot entered the Montreal municipal service in the waterworks department, where he was put in charge of the supervision of the construction of a section of the big reinforced concrete intake pipe. Mr. Lanctot's first connection with the city of Montreal lasted two years, until 1911, when he left the city to join Mr. J. E. Varnier, consulting engineer and land surveyor of Montreal, as assistant engineer on numerous municipal works in the Montreal Island cities of Maisonneuve, Emard and St. Louis. Two years later, in 1913, Mr. Lanctot returned to the service of the city of Montreal, first in charge of certain exproporiations in connection with the city's waterworks and then in the Department of Public Works in charge of the works pertaining to that branch in the northern division of the city. Finally, he was appointed assistant engineer in charge of the entire city sewage system. At the beginning of 1919 Mr. Lanctot was appointed engineer superintendent of the Canadian Highway Engineering Company and had charge for that company of the supervision of large contracts with the highways department of the Quebec government. In 1921 Mr. Lanctot was chosen by the Hull city council as chief engineer of the city, where he has been busy preparing plans for extensive developments and repairs contemplated by the city, the cost of which is to exceed a half million dollars.

Mr. Theo. Lanctot

Mr. Lanctot's natural disposition for engineering together with his 16 years of practical experience make him a valuable engineer and one whose services the Hull city council did not hesitate to take advantage of.

Mr. Lanctot is a member of the Professional Engineers' Association of the province of Quebec.

pression. On the other hand, the federal government proposes not to execute any postponable public work during boom times and thus refrain to that extent from raising the height of the wave of business activity. It is the last straw that breaks the camel's back. In a boom it is the last few hundreds of millions of dollars of orders concentrated into a short period that sky-rocket prices, shake credits, and bring down the structure with a crash. If a sbstantial portion of the amount spent on public works can be held back during years of active industry, the strain will be relieved to that extent. A governor for an industrial engine will have been invented which will steady employment in good times and bad. The Kenyon bill aims to do this as far as federal public works are concerned, but these are only one-fifth the total public works done within the boundaries of the country. Public works of cities are more important because they are so much larger in volume. How can the cities help?

Looking Ahead

A city plan looking ahead ten years and anticipating the probable growth and needs of the city will be helpful in carrying out this policy. When prices are low and labor plentiful, the major features of the plan can be undertaken. During the years of active industry only those projects urgently necessary need be begun.

How can the federal government or the cities know the best years to expand public works By our system of crop reports the business world knows the probable yield of wheat or corn long before it is harvested. By the Kenyon bill a similar report indicating the trend of business will be inaugurated. Specific and general business conditions will be compared month by month in more complete studies and analysis than have heretofore been attempted. These reports would serve as a guide to the federal government. When the wave of private industry is rapidly rising, federal public works would be postponed. When serious unemployment is in sight, at a given signal all accumulated federal public works would go forward. The cities may be expected to make use of this guide and thus make a national synchronous policy possible. Any city which follows such a course will build less of its ten-year total at top prices and at the same time steady employment at home.

Business men may well make profitable use of this survey of business conditions and thus avoid contracting credits which freeze on their hands, and postpone plant extension and large purchases when the wave is near its top. Some large corporations

(Continued on page 150)

Large Hospital at Victoria, B.C.

First Unit of an Extensive Scheme Now in Course of Construction—Details of Layout and Equipment—Good Progress Being Made With Concrete Work

By J. B. HOLDCROFT
Consulting Engineer, Victoria, B. C.

The Provincial Royal Jubilee Hospital, dedicated in 1887 to the great Queen Victoria, has, with the addition of several wards from time to time, served the citizens of Victoria for thirty-five years, and it is fitting that an institution dedicated to that great queen who had so much to do with the growth of our Empire in peace and prosperity during her long reign, should be succeeded by one dedicated to the British Columbian soldiers who fell during the recent great war, giving their lives a willing gift to maintain the peace of the world.

The building now in hand, is the first unit of the ultimate scheme, and is known as the East Wing. It will comprise public and private ward buildings, and provides for altogether 140 beds on four floors. Of these 34 are designed for maternity cases, and are to be located on the third floor which is being specially fitted for this purpose. It will be equipped with two delivery rooms, nurseries and day rooms, etc.

Architect's drawing of the new hospital now being erected in Victoria

This wing is to be a completely equipped hospital in itself, and will not be in any way dependent upon the old buildings which will be maintained in operation pending the completion of the entire scheme. It will have its own operating department and a full laboratory equipment, as well as commodious lecture rooms for use in connection with the nurses' training college.

The operating department will occupy the fifth floor, and is to be most complete and modern in every respect. Six operating rooms will be ranged along the north side of the building, each pair of rooms having a surgeons' scrub room in connection. Special facilities are to be provided for eye, ear, nose and throat cases, and for dental work. The sterilizing room, sink room, nurses' work room, surgeons' common room and lavatory are arranged on the opposite side of the reception lobbies.

The main entrance to the building will be at ground level, and will open directly into a hall from which two large elevators will make connection with the ward floors above. Offices and a patients' receiving room will be on this floor, and at the north end of the building will be located the series of laboratories, including facilities for chemical and pathological work, autopsies, etc., as well as the lecture rooms mentioned above.

Heating and Ventilating

The building will be steam heated on the Dunham system, while a gravity exhaust system of ventilation is to be installed. Climatic conditions are such that ventilation by the open window, together with a special type of direct-indirect radiation can be relied upon as being more effective and manageable throughout the building than the expensive mechanical systems of forced ventilation which were so prevalent some years ago. Mechanical ventilation will be necessarily resorted to, however, in the case of the operating rooms, where the requirements of conditions will not permit of fresh air being brought in directly from the outside.

The excavation and concrete work on the foundations of the building were carried out during the past summer by Messrs. Luney Bros., contractors, of Victoria, B. C., at a cost of $11,482.00. The column bases and pipe subways were excavated in solid rock, and the difficulty of this work was enhanced by the fact that the site of the new building is directly under the windows of one of the old wards. The pipe subways are centrally located and extend the length of the building in both directions. They connect with a previously constructed tunnel leading to the central heating plant and laundry building which was built some years ago as a permanent unit of the institution. In addition to these pipe subways, a piping space of 18 inches has been left over the entire area of the building.

Progress of Concrete Work

A second contract has recently been let for the superstructure, comprising reinforced concrete frame, brickwork and roofing, to Messrs. Parfitt Bros. of Victoria, whose tender for the work was $107,986.00, about $20,000.00 below the next lowest tenderer. Good progress has already been made on this portion of the work, the first floor columns having already been poured and the succeeding slab reinforcement and forms being in place ready for pouring the concrete if the weather continues favorable. As there is so little hard frost on the coast, freezing weather is always considered unsuitable for reinforced concrete work, as it has never become an economic necessity to make use of the cold weather methods so essential in the colder sections of the country.

Contract Bonds for Construction Work

Bond Underwriting from the Contractor's Viewpoint—His Line of Credit with the Surety Company—Confidence in Their Advice

By A. E. KIRKPATRICK
General Manager, United States Fidelity & Guaranty Co., Toronto.

Are contractors as conversant as they should be with the nature and merits of contract bonds? Do owners realize the extent of the protection that a surety company affords through such bonds? It is because the editors do not believe that either contractors or owners as a whole sufficiently comprehend the surety problem that they have undertaken to publish in this and succeeding issues, a series of articles explaining the whole question. The first article appears herewith; the second will be printed in the next issue. They are brief but to the point and will form an excellent treatise on the subject of contract bonds. They have been prepared at the request of the Contract Record, by the manager of one of the leading surety houses in the country.

Any honest and experienced contractor who has created an estate by work and thrift can secure a contract bond and that without putting up any collateral, but his personal undertaking to protect the bond company from loss, but contract bond underwriting is very akin to banking, and the careful bond company loans its credit with as much care and circumspection as the bank loans its cash.

Given two men of equal integrity and practical experience, the financial standing of one may entitle him to borrow much more from a bank than the other can—and it is not any reflection on the latter that his line of credit is less than that of the former, but simply a question of credit rating based on financial ability to make good his obligations.

Likewise and in exactly the same ratio, the applicants for contract bonds, receive from the bonding company a line of credit beyond which experience proves it is dangerous to venture, dangerous to the surety and equally dangerous to the contractor.

Contracting work is hazardous and there is always an element of chance, but this element of chance is not divided between profit and loss on a fifty-fifty-basis, because experience shows that the chances of serious loss are greater than the chances of spectacular success. In other words, it is but seldom that the contractor gets a chance to make a killing on a job, while competition usually keeps him so close to the cost line that dips below this line of costs are an ever present danger, only to be avoided by the utmost care and circumspection, and the prractice of that old maxim, "eternal vigilence is the price of safety".

A line of credit from a bonding company must of necessity be based on the total amount of contracts, not the total amount of bonds. Contract bonds vary in percentage from ten to fifty percent of the contract price, the average however, being about twenty five percent, which, with the customary 15% hold back, is ample security for any owner. As there is no fixed ratio it is manifestly impossible to take the bond as the basis of credit rating.

The measure of profit or loss of the contractor has no relation to the size of the bond, but it has every relation to the size of the contract.

A five per cent. loss on $10,000 job is $500.00, and it is equally certain that a five per cent loss on a million dollar job is fifty thousand dollars. Losses on big jobs are usually present and fully apparent when a contractor fails and the bond company has to pay.

Now the spirit of optimism is nowhere so strong as in the office of a bond company, for considering the numbers bonded comparatively, few fall down. The Bond Company lives only by the premiums it collects, and naturally they want every dollar of premium they can procure so that every influence is working to urge them to write bonds freely and collect more premiums. With years of experience and bitter losses behind them, they must have some reason when they tighten up their credit strings and urge their contractor friend to pause and reflect before engaging his credit to operations beyond the margin of safety demonstrated by time and practice.

Confidence begets confidence. Choose a good bond company and trust them, and thereby gain their trust, and your success is their success and in such a spirit of mutual confidence where you venture they will follow, but do not be impatient when friendly counsel urges enough for the present, clean up and cash in on at least a percentage of your work on hand, before embarking on more. You will not lose in the end, but be the gainer and still be in business growing stronger daily when numbers of your competitors have gone to the wall.

Is it better to have won and lost,
Than never to have won at all?
Or, is it better to have and to hold,
When our three score years are told?

The Performance of Concrete Pipe in Sanitary Sewers

Well Made Concrete Pipe, Complying with Standard Specifications, Does Not Deteriorate Through the Action of Acids and Gases—Municipal Officials Commend Such Pipe

BY M. W. LOVING
Secretary, American Concrete Pipe Association

Some engineers entrusted with the design and construction of sewers are under the impression that harmful acids and gases may exist in sanitary or domestic sewage that will cause disintegration of properly made concrete pipe. This is untrue and is undoubtedly the result of reported failures by competing interests of poorly made concrete pipe and not the modern, A. S. T. M. tested product.

Failures have occurred in concrete sewers which is also true of every other material that has been used for building these structures. Unless proper precautions are taken to correctly fabricate these units they cannot be expected to give the best results. This is a matter, however, for the engineer to take care of.

Domestic or sanitary sewage usually follows the reaction of the water supply and is slightly alkaline. Occasionally some manufacturing waste may be found which from the nature of the manufacture is slightly acid. Some of the most competent consulting engineers of the country contend that such wastes, when discharged into the laterals or interceptors, are generally so small in volume that they are promptly neutralized by the alkalinity of the sewage.

Sewage Generally Alkaline

Sewage contains sulphates, nitrates, chlorides and other salts in solution which are not acids. Analyses of sewage of many American and European cities are presented in Metcalf and Eddy's "American Sewerage Practice" Vol. 3 and George W. Fuller's "Sewage Disposal". From an examination of these analyses it can readily be seen that practically all of the sewage examined gives a slight alkaline reaction.

Studies in connection with the treatment of sewage in Chicago and Baltimore have brought out the fact that the sewage has shown a consistent alkaline reaction for many years. T. C. Schaetzle, principal chemist and bacteriologist of the Baltimore Sewage Treatment Works has found that the sewage treated at that plant has shown a slight alkaline reaction for the past seven years. The Baltimore sewerage system is of the separate type so that the sanitary sewage is probably as concentrated as in any American city.

The following statements by two prominent sanitary engineers are typical of those that have had wide experience in power design and construction:

> "We have plenty of cases in which cement concrete has been used for sewers, extending over a great many years, not to refer to the old concrete sewers of Rome and London, on which I have no detailed and satisfactory information. I know that the large sewers in Paris have been built of rough stone heavily plastered and smoothed with cement so that the sewage flows over the cement surface in the same way as if the entire mass were of concrete. These surfaces at my examination in Paris were quite good. There had been no disintegration. I laid this fact to the density and smoothness of the plaster. In 1881, I closely examined the concrete sewers in Vienna, where many had been built both of large and of medium size. The work had been very carefully done and the sewers had been built from 10 years to 20 years. The sewage is rather strong in Vienna, because the water supply per capita is unusually small. I found no disintegration of the concrete surface, which then looked dense and smooth."—Dr. Rudolph Hering, consulting engineer and sanitary expert, 170 Broadway, New York City.

> "I have been building concrete sewers since 1893. I have had charge of the operation of these sewers up to 1906, during which time I have had occasion frequently to pass through them for examination and inspection, and have never seen any visible effect upon concrete exposed to sewage or sewage gases which might have resulted from the action of the sewage, and I am of the opinion, broadly speaking, that if the concrete is of the proper character, built and placed in the proper way—that is, a dense enough mixture and properly mixed—the ordinary sewage or sewage gases generated from any American city will have no effect whatever upon the concrete."—T. Chalkey Hatton, chief engineer, Sewerage Commission, Milwaukee, Wis.

Left: Laying concrete pipe sewers, showing method of cutting the units.

Right: 24 in. concrete sewer in 12 ft. ditch.

Successful Use of Concrete Pipe

Concrete pipe has been successfully used for many years in sanitary sewerage systems in cities of the United States. The following typical statements of municipal officials are presented:

J. C. Feeley, commissioner of public works, Rutland, Vt., September 22, 1921:— "We have forwarded three lengths of 8 in. pipe (concrete) that has been in continuous use for a sanitary sewer on River Street in this city for 35 years. Despite the fact that it has been on a 3 per cent grade, where the velocity has been high, you will readily see that this pipe is as perfect to-day as the day it was cast and I would not hesitate to relay it on some of our other streets. This pipe is known as the Ripley concrete pipe and was made to a considerable extent in 1885. While it has not the strength of modern concrete pipe as it is made to-day, with good modern practice, we consider it one of the best demonstrations of the ability of concrete pipe that has come to our attention."

J. L. Temple, Commissioner of Public Works, North Adams, Mass., November 10, 1921:—"You might be pleased to know that cement pipe was manufactured here in North Adams from 1874 to 1879 and there is still in use at the present time sanitary or domestic sewers 8 in. and 12 in. of this very pipe laid at the time it was manufactured and which shows no signs of deterioration and has proved satisfactory."

H. J. Wiegenstein, Commissioner of Public Works, Butte, Mont., November 3, 1921:—"Use concrete pipe in all sanitary and storm sewers. Don't know of any failure of concrete sewers in Butte. Some have been used for over 30 years. Concrete pipe preferred in Butte."

Fred Davenport, consulting engineer, Kokomo, Ind., March 30, 1921:—"The city of Kokomo is now constructing a large relief sewer system of which I have charge of the design and construction and we will shortly remove some concrete pipe that was placed in 1873. This sewer has been in use as a combined storm and sanitary sewer and from the inspection I have made of it it seems to be in first class condition. As this pipe has been in service forty-eight years, it is the oldest concrete pipe that I have seen carrying sanitary matter."

F. J. Anderson, city engineer, South Bend, Ind., November 1, 1921:—"City has one half mile of plain concrete sewer under 24 inches laid in 1899. Sewer has been very satisfactory. Used for storm and sanitary purposes."

Types of Pipe

Two classes of concrete pipe are commonly manufactured, reinforced and plain. Reinforced concrete pipe is produced in standard sizes between 15 and 10 inches in internal diameter and is a very desirable sewer building material on account of its great strength and ability to withstand the loads in deep fills and the superimposed loads caused by the passage of heavy vehicles when the sewer is located near the surface. Besides, its permanence and smooth interior are distinct advantages. To illustrate the latter quality, assume for example a five foot or 60-inch sewer laid on a slope of one foot per 1,000 feet. The co-efficient of friction, N=.011 in Kutter's formula is commonly used for concrete pipe sewer design. For other types of construction the co-efficient N=.015 is used. The capacity of a 60-inch concrete pipe sewer based on the above conditions is 40 per cent greater than in the case of other materials where the larger coefficient is used. This is a distinct advantage from the standpoint of design and economy.

Plain concrete pipe is commonly manufactured in standard sizes between 4 and 30 inches internal diameter. The outstanding features of this pipe are its great strength, permanence and low percentage of absorption. The concrete used for fabricating this pipe is of a dryer consistency than that used for reinforced pipe but this is a distinct advantage as the concrete approaches the ideal consistency that gives maximum strength. Also, this pipe is fabricated by machinery in which the concrete is placed under enormous pressure, thus compacting the mass and making possible very low absorption. The American Society for Testing Materials has adopted standard specifications for this class of pipe and engineers interested in sewer construction are urged to secure a copy of these specifications from the society at 1315 Spruce St., Philadelphia, Pa.

Stabilization of Private Industry Through Public Works

[Continued from page 146]

already have their own experts to chart these movements, and as a result a number of them came upon the present depression fully prepared. The profits they earned by being able to buy freely after the drop and to manufacture while their competitors were overstocked at high prices were profits well earned. Each one of these corporations did its share in diminishing the depression because it had checked its own expansion during the rise. At school we learned that little drops of water, little grains of sand, make the mighty ocean and the wondrous land. Every little industrial plant and every little town can add a grain to the stability and safety of the whole country.

If twenty per cent of all public works are postponed during good years and executed in one year of depression which may come once in ten years, public works can lift one-half the weight of a serious depression in factory production. After making allowances for all variations in production, such as mining, transportation, etc., it is estimated that public works can be arranged to make up one-third the total of variation. In reality it can do more; it can lengthen the intervals between depressions by diminishing the height the wave is allowed to reach at any time. Such a program vitally affects the construction industry. When fully carried out a contractor will be assured that when private contracts are scarce public contracts will be more plentiful.

Practicability of the Plan

Two proofs of the practicability of this program are at hand. In the year 1921, when private industry was employing a lower percentage of men than ever before, as far as we can judge from available statistics, public works were employing twice as many men. The war had checked public works in the same way that the Kenyon bill proposes to do during peace times of active industry. Consequently part of the accumulation was ready to hand. The municipalities prepared more public work than ever before, when private corporations were making a minimum of expenditure for new enterprises.

The other proof is equally striking. Heretofore the bulk of road construction has been concentrated into a few summer months. Preparations were made slowly during the spring. Now for the first time manufacturers of tractors and road machinery report that they received orders in December which formerly did not come to them until April. Consequently, work will be fully under way on the roads several months earlier in 1922 than heretofore.

Clay Products Manufacturers of Canada Meet in Toronto

Twentieth Annual Convention of the Canadian National Clay Products Association—Resume of Proceedings and Addresses

A large gathering of delegates, including many representatives from the United States and distant points in Canada, were present at the opening session of the 20th annual convention of the Canadian National Clay Products Association, on Tuesday morning, February 7, at the Carls-Rite Hotel, Toronto, and were briefly but warmly welcomed by Mr. Charles A. Millar, chairman of the entertainment committee. Very little time was lost with preliminaries, as the first session included a good deal of routine business. The president of the association, Mr. Ryland H. New, commenced the proceedings by the reading of his annual address, which is presented in abstract herewith:

President's Address

"For some years the clay industries have been able to cope with adverse conditions such as were bound to come during the crisis our country was in, and the time has now come when we must look ahead and broaden out in all lines of the work. In order to look ahead successfully we must not forget to look back, so that we may profit by our own mistakes and the mistakes of others.

"With building conditions improving, the need of and the demand for all lines of clay products will become greater and it is for our own good that we produce the best possible article and satisfy dealers, architects and the public, with the quality of the goods that they are buying. We know the merit of clay industries and we must educate others to our point of view.

"Our association, while confining its energies largely to the task of developing the clay industries, has tried earnestly to co-operate with those representing other occupations and activities. The interests of various groups may conflict at times through natural and economic causes, but the solution of these difficulties must come through co-operation and not disruption. Division into groups, each aiming to secure material advantages for its members, is the sure path to failure. Co-operation, recognition of the rights of others, and honest attempts to reconcile conflicting claims is the only way to success. Grouping of people, according to their classes, leads to group government by a parliament and legislatures composed of a number of bodies of men, each striving to secure legislation favorable to its own group or class and in many cases detrimental to others.

"During the past few years there has been an increase in legislation tending towards the reduction of hours, the fixing of minimum wage, compensation for injuries, as well as general legislation of a social character. The effect of this legislation is to decrease the amount of work done by each individual and to increase the cost of finished products to consumers and to divert money from capital investment, which would in time increase production and provide employment. In so far as this legislation aims at improving the living conditions, and adding to the happiness and comfort of the citizens, in whose interests it is passed, it is worthy of support. The vital question is—how far can this tendency be carried safely?"

The next items of business, in order, on the program were the report of the secretary-treasurer, Mr. G. C. Keith, and the report of the executive committee, also read by Mr. Keith. The former report showed a small cash balance on the credit side of the books, and was adopted as read, by the meeting. The report of the executive committee dealt briefly with the activities of the association during the past year, reporting the progress made on business matters of vital interest to the industries represented in this body—the fight against the use of prison-made brick on government structures; efforts to secure lower freight rates on clay products, etc. The report also suggested slight changes in that part of the association's constitution dealing with the subject of membership. This report was adopted on motion of Mr. A. Dodds, seconded by Mr. T. H. Graham.

Mr. R. H. New, President of the Canadian National Clay Products Association

The 1922 Officers

There being no business arising out of the reading of this latter report, the meeting went ahead with the next item of business, the election of officers. Mr. T. Kennedy, chairman of the nominating committee, read the list of candidates, as compiled by his committee, which list, as presented below, met with the universal favor of the meeting: President, Ryland H. New, Hamilton, Ont., 1st vice-president, T. H. Graham, Inglewood, Ont., 2nd vice-president, Andrew Dods, Mimico, Ont., 3rd vice-president, D. C. Merkley, Ottawa, Ont., secretary-treasurer, Gordon C. Keith, Toronto, Ont.; auditors, Messrs. Andrew Dods and C. B. Lewis; councillors, Messrs. H. H. Hallatt, N. T. Gagnon, F. D. McFarren, C. B. Lewis, Robert New, W. H. Nicholson, George Price and C. H. Wallace. The following chairmen for the various committees were also appointed, with power to choose their members: Entertainment committee, C. A. Millar; technical education, Wm. Burgess; tile, H. H. Hallatt. It was moved and seconded that the president appoint a resolutions committee, he naming Messrs. W. H. Freeborn, of Brantford, and D. C. Merkley, of Ottawa, to constitute this committee.

Handling Clay With Conveyors

Mr. William Burgess, superintendent of the Don Valley Brick Works, Todmorden, Ont., then read a very interesting paper on "Handling Clay With Conveyors," which is published almost in its entirety.

Mr. Burgess also added a few words commending the use of the bucket conveyor in clay plants of sufficient size to justify the purchase, for the handling of coal on and off railway cars, loading of wet clay on cars, etc. He stated he did not think there was a part of their plant that paid better dividends than the bucket conveyor, it taking the place of five men in loading and unloading work.

In the discussion following Mr. Burgess' paper, several present were of the opinion that the method of running belt conveyors over boards, instead of rollers, had its good points and did not result in the rapid wear of belting, as was generally thought. Several speakers cited instances in their respective plants where belt conveyors had been run over boards for periods of from ten to fifteen years, resulting in no undue wear upon the belt, but necessitating the replacing of the boards from time to time. The advantage of the conveyor on boards was the retaining of the materials better than on the conveyor on rollers, by reason of the more even belt surface in the former case. It was thought, however, that a belt conveyor over boards would require more power to operate than the idler system, and, although no statistics as to the relative period of belt wear for the two systems were available, it was thought, by one member, that the conveyor over rollers would wear one-third longer than over boards. The discussion was an excellent one, and served to correct an impression that many members had that a belt over a board would wear rapidly from contact with the board.

Mr. R. B. Morley, secretary of the Industrial Accident Prevention Association, was the speaker at the noon-day luncheon, Tuesday, his subject being "Safety and Compensation Costs".

The afternoon session on Tuesday was given over mainly to the reading of several interesting papers, the first by Prof. W. G. Worcester, of the University of Saskatchewan, on the subject "Ceramic Work in Saskatchewan," which is reproduced, almost in full, elsewhere.

"Burning of Face Brick at the Bradford Brick & Tile Company's Plant," was the subject of an interesting address by a representative of the American Dressler Tunnel Kilns, Inc., of Cleveland. The address was illustrated by moving pictures, which depicted the methods employed in the burning of brick at this up-to-date plant.

Mr. L. Haigh, of the American Clay Machinery Company, Bucyrus, Ohio, followed with a paper on "Handling Brick." The speaker explained in detail the mechanical handling of green brick in the kiln and the removal of the brick from the kiln to railroad cars or trucks. He dealt with the many advantages of the Penfield Automatic Setting Machine for handling brick from the dryer car to the kiln—saving in labor, saving in breakage, saving in time, etc.—over the old method of tossing from drying car to a setter.

All delegates at the convention, together with their wives and lady friends, were guests of the Entertainment Committee, at a theatre party at Shea's Theatre, on Tuesday evening.

Second Day's Proceedings

The first paper read at the morning session on Wednesday, was on the subject "The National Importance of the Clay Industries" by Mr. A. G. Dalzell, of the Vitrified Clay Pipe Publicity Bureau, Toronto. This paper is reprinted in abstract form below.

The National Importance of the Clay Industries

In Mr. Dalzell's paper the history of the clay industries was shown to be co-eval with the history of man, Greek mythology recording that following the gift of fire by the gods to mortals, the first woman Pandora was made of clay. For much of the knowledge we have of primitive man and many of the nations of antiquity, we are indebted to records of burnt clay or memorial urns. Many of the peoples of the past have, through their works of art in clay and porcelain, perpetuated their ideas, their religious beliefs, their customs and mode of life in a way that could never have been done in perishable literature. This art is almost lost, but John Ruskin hoped it would be revived and improved so that the finest conceptions of our artists could be recorded in pictures "as brilliant as painted glass, as delicate as the most subtle water colours, and more permanent than the pyramids."

The importance of the clay industries to Canada was shown to be the providing of building materials of lasting and fireproof character to replace so much of the lumber and perishable materials now so freely used. No material reduction in the very heavy fire losses of Canada could be looked for until this was accomplished. By means of a large map supplied by the National Resources Intelligence Branch of the Dominion Government, it was shown that clay deposits and clay working plants were fairly well distributed throughout the Dominion, the greatest handicap to fuller development being the necessity of importing fuel.

The part played by products of clay in the construction of sanitary sewers and sanitary ware was pointed out, also the essential importance of the clay industries to metallurgical and chemical industries. The need of greater application of scientific and technical knowledge in the working of the industry was emphasized and the example of Germany in this matter was mentioned. Few individual clay industries could afford to undertake scientific research and experiment and the necessity of the co-operation of the industries with the universities and scientific bodies is thus necessary.

Though governments have not as yet looked favorably on the establishment of departments of research, unless there was some co-operation from the goverment or the universities it was not likely that scattered industries like the clay industries with their limited capital would be able to compete with similar industries of larger and more progressive nations.

Mr. S. R. Walsh, of the Goodyear Tire & Rubber Company, New Toronto, then spoke at some length on the subject of "Belts", a very important part of the equipment of any brick or clay plant. The speaker contended that the users of belts did not properly appreciate the importance of this part of their equipment, did not see that the proper type of belting was used on certain pulleys, (a point which he placed particular emphasis upon) and did not avail themselves of the expert advice of the companies manufacturing belting on the proper type and thickness for certain conditions, care, etc. This attitude, he stated, resulted in the failure of belts which had been improperly adapted, through no fault of the belt itself. He cited several instances of belt failures in plants throughout Canada which he had investigated, and explained the causes of failure in each instance. Mr. Walsh's interesting talk, no doubt, brough home to his listeners a stronger realization of the importance of properly belting drives, and, the importance of proper care afterwards through periodic inspection. A vote of thanks to Mr. Walsh for his interesting and instructive talk was proposed by Mr. Kennedy, seconded by Mr. Burgess, and unanimously responded to by the members.

The president then called upon Mr. J. B. Carswell, president of the Association of Canadian Building & Construction Industries, who addressed the meeting on "The Outlook in the Building Industry", substituting for Mr. J. Clarke Reilly, secretary of the above association, who found it impossible to be present. The building industry is so closely connected with general business prosperity, the speaker stated, that it is impossible to predict the future of building activity, it depending entirely on the condition of business prosperity. The building industry has been designated "the barometer of prosperity". In it are engaged approximately 300,000 workers throughout Canada. "If business is bad in the steel trades", said Mr. Carswell, "business is generally bad in Nova Scotia. Again, if the cotton trade is bad, the city of Sherbrooke suffers, but if the building industry is bad, the whole country is affected." The building industry, he pointed out, is an industry that thrives in every centre throughout the country and is the "cure-all' for depression But prosperity must go ahead first. Building costs are down 35 per cent from the 1920 peak, he stated, but it is the general impression in the industry that the tendency in the future would be slowly downward, in fact, a slight increase was looked for by some, due to the abnormally low cost of steel work at the present time, a very big factor in the construction industry.

Labor Efficiency

Mr. Carswell enumerated the four big items in building construction as follows: (1) labor efficiency, (2) labor rates, (3) material costs, and (4) profits, and the biggest factor, in his opinion, in influencing the ultimate cost, was item No. 1, "labor efficiency.' He referred to the cost of clay production, contending that the actual cost of the clay must be small in comparison to the cost of labor in producing the finished brick. Freight costs, also, he stated, represented 80 per cent for labor. So in the construction industry, labor represented 80 per cent of the ultimate cost. "If we could get the men within four walls,, he went on, "and talk to them, reason with them, I am sure we would have no difficulty in co-operating, but we cannot. We must deal with the walking delegate, who does not represent the true interests of labor. Until we have solved this difficulty, we cannot have successful co-operation." He did not wish his words to be misconstrued as condemning labor unions, in fact he stated that personally he preferred union labor, but was of the opinion that the walking delegate or business agent has been a big factor in preventing the hearty co-operation of capital and labor.

In his closing words, Mr. Carswell stated that architects all over the country are reporting lots of work on hand. He did not look for a boom period in the spring, but for a return to normal business. "We must get rid of this monster 'depression' and talk up prosperity, and this period of slow business will disappear." Mr. Carswell suggested closer co-operation between the two associations in view of the similarity of interests, which suggestion met with the hearty appreciation and approval of the president in his reply to Mr. Carswell.

A vote of thanks to Mr. Carswell was proposed by Mr. Burgess, seconded by Mr. Kennedy, and enthusiastically responded to by all the members.

Mr. Theodore A. Randall, of Indianapolis, secretary of the National Brick Manufacturers Association, addressed the convention at the noon-day luncheon on Wednesday.

Wednesday afternoon was set aside for visiting local brick plants, many delegates taking advantage of the opportunity of seeing the plants of the Don Valley Brick Company, Ontario Sewer Pipe Company or the Booth Brick & Lumber Co. Ltd. Automobiles were provided for the convenience of the visitors.

The annual banquet of the Association was held in the Carls-Rite hotel on Wednesday evening, several prominent men in the clay and building industry being present. Mr. J. B. Carswell, president of the Association of Canadian Building & Construction Industries, referring to the recent convention of his association in Hamilton, said, "I feel sure that the depression in our line is over, and in that I express the conviction of three hundred men who met at that convention." The element of the rise in British exchange would be an important factor, he thought in stimulating building by providing money. "As soon as the exchange rights itself and money can come here without loss there will be an improvement", he said. With a building boom the industry would still have its problems. In Toronto, for instance, he doubted whether there would be enough building mechanics and certain material to meet the demands.

Mr. S. R. Parsons, representative of employers at the International Labor Conference at Geneva, was the next speaker. He emphasized the need for cooperation between individual employers and workers, saying. "It doesn't matter a straw to the employee whether he is a member of a union or not, so long as he is treated right where he works." He deprecated the policy of labor and employers organizing into separate and opposed armies. "Industry will never get into better conditions through organization by one or the other of these groups," he declared, "but by sincere effort to co-operate in individual units of industry and individual plants."

Mr. Parsons explained several means by which this had been tried by inducing employees to invest and share in the business. "They will never consider themselves 'wage slaves' then," he declared. "When they have stakes in the country of their own they will not join in any Bolshevist attempt to jeopardize them. The leaders of Canadian industry did not gain their position by adherence to the eight-hour day."

Mr. B. E. Bechtel, of Waterloo, Ont., the first president of the Association, followed Mr. Parsons, with a few optimistic remarks on the building situation in his district. Other speakers at the banquet were Dr. Currelly, of the Royal Ontario Museum, Mayor Maguire, of Toronto, who welcomed the delegates on behalf of the city, Professor W. G. Worcester, of the University of Saskatchewan, and Mr. Andrew Dods. The latter gentleman officiated as toastmaster at the banquet.

Ceramic Work in Saskatchewan

Provincial Government is Undertaking the Development of the Clay Industries—Survey of Clay Resources and Establishment of University Course

By PROF. W. G. WORCESTER
University of Saskatchewan

Unique in the history of Canada is the work recently undertaken by the Saskatchewan government, in the matter of its clays and clay product industries. It has long been recognized that the province is preeminent as to its raw materials for the production of brick and pottery.

During the past, numerous plants have been established for the manufacture of structural claywares, but for some unaccountable reason only a small per cent of these have succeeded in their efforts. Feeling that, fundamentally, there must have been some basic cause for the disappointments, Hon. Chas. A. Dunning, Minister of Labor and Industries for Saskatchewan, set about to devise ways and means to locate, if possible, the cause of the fatalities among the brick plants, and to be in a position to safeguard against similar losses of money in the future, and further, to assist those plants already in operation to attain the greatest efficiency and economy in their work.

Upon considering the scope and ultimate value of this work to the province, careful study and consideration was given to the problem. From these deliberations it was apparent that there were two factors to be dealt with; first: it would be necessary to prepare a survey of the ceramic materials and plants of the province, making careful tests and recommendations in each case as a guide for future work and development; second: the ultimate development of the clay resources of the province, along safe and economical lines would require the services of men specially trained in the science of ceramics.

Ceramic Course Established

The question arose as to where to obtain these men. In the United States a limited number of the universities include a department of ceramic engineering in their curriculum, the graduates being rapidly absorbed in that country, but in all of Canada there was not one school from which men of the proper training could be drawn. It was thus decided to establish at the University of Saskatchewan a department of ceramics, with a trained man in charge whose duties at first would be largely those of conducting the field survey and rendering assistance to the present clay industry as a whole, with a possible limited amount of teaching.

To facilitate the work there has been installed at the university a very complete ceramic laboratory for the testing of all grades of clay. The equipment consists of jaw crushers, rolls and other grinding machinery, an auger brick machine, dry press, repress, pottery machinery, such as blungers, screens, filter press, throwing and jolly wheels with pull down, glaze and ball mills, a dryer adjustable to fast or slow drying, an oil-fired kiln, pyrometer installation and furnaces for testing the highest grades of refractories. Equipment is also accessible for microscopical work, chemical work, tensile cross breaking and crushing tests; in fact, a very complete and creditable department has been inaugurated, especially in view of the comparatively short time since the work was undertaken.

The Work Carried Out

With reference to the survey or field work, it may prove of interest to learn the nature of the work and the policy followed. Contrary to the usual methods, credited to the West, the aim at the start has not been one of boosting to bring in new industries, but rather to assist and see that the present plants are working along lines that will afford them a favorable chance for success. In other words, it is fully recognized that one successful concern is of far greater benefit to the public than several down-and-outers, to use a crude expression.

Some of the work done has been that of testing the clays from all of the present plants, and in light of the information thus obtained, suggestions and assistance has been furnished. In one case a change in the method of burning is under way; in another, the line of ware that has been manufactured in the past is being changed to that of one better suited to the raw material; in a third case, the matter of altering the method of manufacture is being studied with a view to producing a better grade of ware; still in another case, it may be found necessary to move the plant or ship in material from other parts of the province. The above problems are fairly representative of the class of work that the department is called upon to do.

In Saskatchewan, as elsewhere, the general public takes little heed of the things most abundant or nearest to them. Thus was it found in the matter of clays and claywares in the province. While Saskatchewan is for the most part a treeless prairie, the majority of homes are frame, constructed at approximately the same cost as a fireproof structure of brick or tile. It undoubtedly was not any preference of the owner to use lumber, but, rather he did not know or realize that clay products were obtainable and within his reach. In fact, no one had ever pointed out their superiority and ultimate economy.

Clay Products Intelligence Bureau

Feeling that a greater service could not be rendered the province as a whole than to place before the general public an exhibit of clay products which would be representative of the various manufacturers, and further, to supply information relative to building costs, names of dealers and producers, a Clay Products Intelligence Bureau was formed. This work was successfully undertaken during the past season at the exhibitions of the two largest cities of the province, Regina and Saskatoon, where numerous panels illustrating bonds, patterns and colors of brick and building tile were shown, as well as a large assortment of Saskatchewan pottery and raw clays. It is the intention to elaborate upon the work thus started and to make it of far greater value, if possible.

A careful and systematic survey of the more outstanding undeveloped clay deposits is also under way. In most cases the work is being confined to those deposits at or very near to transportation. At each point studied, close attention is given to every detail, such as depth and extent of material, accessibility to transportation, mining or winning problems, water supply, cost of fuel, market conditions and extent of market, freight rates and in fact, every point that may enter into its final development is taken into consideration. In the meantime a complete set of samples of deposits has been taken and sent to the laboratory where it passes through a preliminary test to determine whether it possesses possibilities as a suitable material for manufacture. In case the preliminary test is promising, a more rigid and thorough examination is then made, which finally includes the making of full sized ware. Should the prospective sample meet the required tests, a complete and final report is then made setting forth every detail pertaining to the deposit and tests. This report, with samples of the raw material and burned trials or test pieces, are then filed away for future reference to be referred to in case of inquiries relative to clays from any particular part of Saskatchewan or for materials suitable to certain purposes or lines of manufacture.

It may be said that among the clays tested up to the present there have been fire clays, china clays, including the ball and stoneware clays, terra cotta clays, paving brick, buff and red face brick clays, numerous clays for the manufacture of the more common lines of clay products and clays for paint and paper manufacture. Notwithstanding all of these, only a very small portion of the province has been covered, so that some idea of the volume or magnitude of the work may be obtained.

Handling Clay With Conveyors

The Use of Mechanical Devices for Carrying Clay in Brick Plants—Experience at the Don Valley Brick Works—Merits of Straight and Troughed Conveyers

By WM. BURGESS
Superintendent, Don Valley Brick Works, Todmorden, Ont.

The problem of conveying clay, both before and after drypanning, by a method which is at once simple, economical and generally satisfactory is one which, with the advance of modern needs, is brought prominently before all clay products manufacturers. There are several designs of conveyors in vogue at the present time. I think the best of them, for clay handling, is the belt conveyor, which is an endless belt, running sometimes horizontally, sometimes obliquely, and again partly horizontally and partly obliquely. It has simplicity of design, comparatively low initial cost and requires little power to drive it.

This type of conveyor consists of four parts: (1) drums, on each end; (2) conveying rollers, either straight-faced or concaved—sometimes called troughed; (3) the necessary frame work, and (4) the belt itself, upon which the clay is conveyed. In deciding the details of a conveyor for handling clay, the following factors should be kept definitely in mind: (1) the quantity to be carried per day; (2) the points from which and to which the material is to be carried, and (3) the method by which you are going to drive.

There are a number of ways for handling and storing clays and shales, depending on conditions and locations of plant, length of season, kind and quantity of ware, kind of clay bank equipment, distance to be carried, whether wet or dry clay, arrangements of factory, money available and expenditures justified. We use the troughing type on part of our conveyor equipment and the flat in places where we wish to deposit clay in the storage shed. The troughing type has a greater capacity than the flat belt, when the width of belt is the same. The flat belt has its advantage, however, by reason of the fact that you can push the clay off the flat belt at any point by placing a board or sheet of iron the width of the belt under the belt at the point where you want to deposit the clay. Some users claim that a flat belt lasts longer than a troughed belt, but as we have only been using our clay conveyors about 10 months I cannot say as to that. I do not see any difference yet. While we use a board under the belt where we brush the clay off into storage shed, we keep the board about ¼ in. below, under the side of the belt, the under board keeping the belt close up to the wiping-off board, and when wiping-off board is lifted, the belt runs free and does not rub.

For a troughed conveyor, the outside idlers are set at an angle to form the trough you require, but no conical idlers should be used, as their circumferential speed varies, causing rubbing and wear on the belt, which shortens its life. Fair-sized head and tail drums lenghten the life of the belt. The belt should run about 130 ft. per minute.

Trouble with Gravel

Last year we ran into difficulties by coming in contact with small gravel seams in our clay bank. The seam at one point on a 65 ft. bank was from three to six inches. Not much, you might say, on a 65 ft. bank, but when you realize that the largest of the pebbles were not larger than a marble, and from that down to the size of peas and smaller, you will see that there was a lot of lime blows in the brick. The question was to eliminate this difficulty and still maintain the production of brick, and after a great deal of thought and study, we decided to dry pan all the clay, knowing that the dry pan was an eliminator of lime pebbles. Then the question was how to granulate the clay, remove the larger stone from it (which we had done in the past with conical rolls) and get clay deposited in front of each of our eight dry pans, and also to take care of any surplus clay which the pans could not handle, and then to make provision for wet weather or breakdowns of steam shovel.

To start with, the granulator was placed near the clay bank, so that clay could be dumped into it from the cars, with conical rolls under the granulator. Clay drops from the rolls to elevator boot and is then carried up on a bucket elevator to the top of the storage shed, a height of 35 ft., dumped on a conveying belt, 16 in. wide and 100 ft. long, or the full length of storage shed. This belt is nearly all running on flat idlers, so that the clay can be scraped off into the shed. At the drive end, another belt, 50 ft. long, running at right angles to the main belt, delivers clay to the four different dry pans. A long swinging spout delivers clay at convenient spots.

Under the buff clay storage shed, there is a tunnel 5 ft. wide and 6 ft. deep, in which there is another conveyor belt which carries the clay in the shed back to the same elevator that carries the clay up in the first place.

About the middle of the top conveyor, there is a double pulley device which dumps the clay into another conveyor belt, 150 ft. long between head drums, which carries the clay along and down spouts to each of the other four dry pans. The clay can, if necessary, be deposited into a storage shed used for storing red burning clay. There is another conveyor under this shed, which takes the clay along to the elevator and up to the same spouts as the top conveyor dumps into, thence down into the four drv pans.

The top of the tunnel, under the storage sheds, is covered with railroad rails and plank, with short pieces of plank capable of being lifted up when emptying the shed. In trying to fill our sheds up to capacity, we were puzzled as to how to fill them right up and get a place to start empty. After trying building a brick shaft, which was unsatisfactory, we hit upon the plan of building up 9 in. sewer pipe as we filled in the clay. When we want to empty, we just take off one pipe at a time as the clay lowers in the shed. One man can keep two dry pans going with ease.

The four last mentioned dry pans are about 200 ft. from the machines, which use the clay they grind, and all they produce is carried to the machines on a 200 ft. conveyor, 18 in. wide, running on flat idlers at 130 ft. per minute. This belt will carry enough clay to make 90,000 brick in 9 hours. Clay or dust, as we call it, is deposited in a large hopper placed over the machines.

The belt should be tight enough to prevent undue sagging between the idlers or rollers. If the clay is very wet and sticks to the belt, it should be periodically inspected and the drum pulley over which the belt runs should have iron scrapers placed so as to keep the small pieces of clay from accumulating on them, and a few side guide rollers to keep the belt from rubbing on the side of the frame work.

Labor represents the heaviest charge against clay products and in view of this fact, we find a great demand for labor saving equipment. The wheelbarrow has always been a part of the brick plant, and it is not probable that we will be able to dispense with this old friend entirely, but it must be remembered that every trip made with a barrow of material necessitates a return trip with the empty barrow and, therefore, the waste of one-half the wheeler's time. When we can get something better, it behooves us to eliminate the old barrow as much as possible.

I believe conveying belts are the best device for handling clay either direct from the clay bank or in the ground dust state, and clay workers cannot become too well educated as to its uses, so that we can take advantage of the belt system for moving clay and other materials from one point to another.

Pavement Along Railway Tracks

Engineers have used various methods in an effort to obtain a successful type of construction for paving along railway tracks. They have been confronted with this problem of devising the most durable and economical pavement, one that will have resilient qualities capable of absorbing the vibration caused by passing cars, and which will prevent water percolating through to the base of the tracks, thereby weakening the foundation.

The pavng along the railway tracks of Dalton Avenue, between Santa Barbara and Vernon Avenues in Los Angeles, Cal., is an experience of many years and is brought to the attention of engineers as a worthy example of the inherent qualities of asphaltic concrete pavements for this type of construction. The manner in which it was constructed is described as follows by the Highways Information Service:

Upon the soil, which is a heavy "black adobe" was placed crushed rock having a thickness of six inches after rolling. The ties were laid on this base, then a layer of crushed rock was placed around the ties and well tamped to a thickness of nine inches. The surface consists of a four-inch asphaltic concrete pavement, Warren type. This work was completed in 1915, and to date the maintenance has been nothing, the pavement being in perfect condition.

Home Exposition at Edmonton

Edmonton, Alta., is planning a Home Building Exposition. At a meeting at the Board of Trade rooms recently, the various committees to look after the details of the exposition were appointed. A model bungalow, 24 ft. x 40 ft. will be constructed, and applications are now being received from building supply manufacturers and dealers who desire space to exhibit their products. The executives of the exposition are planning several entertainment features, among which will be the showing of several interesting films depicting the manufacture and development of various building materials.

The University of Montreal has asked the legislature for a $150,000 grant for the establishment of a radium laboratory.

Underwriters' Requirements in Regard to Municipal Water Works

Systematic Studies by National Board of Fire Underwriters Have Led to a Grading System for Cities and the Enunciation of Fire Protection Requirements

BY ROBT. E. ANDREWS

Before the American Water Works Association (California section)

The Baltimore conflagration of 1904 was the immediate cause of the entry of the National Board of Fire Underwriters into municipal affairs on a large scale. During the fourteen years previous to that date, a large number of reports on cities had been prepared by single inspectors, usually fire chiefs of long experience, and, as was natural from their training, little space was devoted to water works. The Baltimore fire caused a direct property loss of $50,000,000 and aroused the insurance companies to the possibility of similar fires in other cities.

This conflagration was carefully studied from many angles and the preparation of reports on all large cities was begun in a systematic way. Instead of single inspectors the work was carried on by parties composed of engineers specially trained in the branch of the work they were to handle. In addition to description and criticism of water systems, the reports outlined fire departments, fire alarm systems, actual structural conditions and law ordinances relating to building and to fire hazards—all leading up to a discussion of the possibility and probability of a conflagration—and followed by recommendations for improving conditions thought to be unsatisfactory.

By 1916 approximately 300 cities had been reported on, some of them three times. The amount of information acquired in the prosecution of this work was enormous. Enough data were on hand so that careful studies could be made of the various features upon which effective fire protection depended. Conditions in one city were compared with those in others of the same class. Conclusions were no longer based on opinion but on the results of many years of experience. If, for example, we asked that a distribution system be composed of mains of certain sizes, it was because thousands of tests had told us that suitable quantities of water for fire protection could not be obtained unless the mains were of the sizes recommended.

Grading System

In fact, we had so much information in our files and had acquired so much experience in this particular field, that we felt justified in taking an ambitious step forward—namely, grading cities with reference to their fire defences and physical conditions.

The plan adopted is like that of making a schoolboy's examination paper, where so much is taken off for every mistake. The sum of the maximum points of deficiency totals 5,000 and is divided in accordance with the relative values of the features as follows:

Requirements of Fire Underwriters

	points
Water supply	1700
Fire department	1500
Fire alarm	550
Police	50
Building laws	200
Hazards	300
Structural conditions	700
Total	5000

That is, a city where the fire defences and physical conditions are excellent would have few points of deficiency, and one where conditions are as bad as possible would approach 5000 points.

The grading schedule has been received with marked enthusiasm. A number of engineering societies, some of them national in scope, have investigated the schedule and given formal approval. Insurance rating organizations use it for classifying cities and towns. Its use for this purpose precludes any possibility of discrimination and allows every town to know in what respect and to what extent its fire defences are deficient. As a guide for outlining improvements for fire protection it is invaluable.

A water works is judged from two view-points, adequacy and reliability. To be considered adequate, a system must be capable of supplying a reasonable quantity for fire protection for a period of ten hours, in addition to domestic consumption at the maximum daily rate.

The quantity asked for fire protection in the central business district, is usually that determined by a formula based on population, which was worked out by Metcalf, Kuichling and Hawley. The quantities required increase in a graduated manner depending on the population. For 1,000 population the required fire flow is 1,000 gals. per min. For a city of 200,000 the flow is 12,000 gals. per min. When the population exceeds 200,000 provision should be made for two fires occuring at the same time, and we ask for 12,000 gallons a minute for the larger fire and from 2,000 to 8,000 gallons for the second fire. The total quantity in all cases includes an allowance for loss from broken connections and hydrants left open, incidental to a large fire. Occasionally the quantity indicated by the formula is modified as required by unusual local conditions.

The time limit of ten hours required for the fire flow has been determined upon as closely approximating actual needs. Nearly all conflagrations have lasted much longer than this—some of them ten times as long. The use of water, however, begins gradually and increases for several hours as more lines of hose are brought into play. The peak load ordinarily continues several hours and as the fire is brought under control the quantity gradually becomes less. Ten hours of full fire flow probably amounts to the average quantity of actual flow at the variable rate. For towns under 2,500 population the time limit has been reduced to five hours.

In speaking of the fire flow required, I characterized it as being reasonable. It is merely the quantity which good practice demands should be availiable and not that which might be needed under the most extreme conditions. In the Baltimore conflagration water was actually used at the rate of 33,000 gallons a minute, yet in our reports we asked only that 12,000 gallons a minute should be available about any block in the congested business section, with 6,000 gallons a minute additional for a second fire occuring at the same time.

Reliability of Water System

The second viewpoint by which a water system is judged is reliability. In general, reliable fire protection requires duplication of such parts of a water system as may reasonably be expected to become inoperative. Aqueducts of good design and of substantial construction, such as masonry or concreted steel, are considered sufficiently dependable as not to require duplication.

It is recognized that a so-called gravity system—one delivering supply direct to the city from the source without the use of pumps, is preferable from a fire protection standpoint, but a well-designed and properly safeguarded direct pressure system, such as the high pressure fire systems of some of our large cities, so nearly approaches the gravity system in adequacy and reliability that no distinction is made between the two types.

The introduction of storage, either elevated and supplying the distribution system or for suction supply, off-sets to a greater or less degree the need of duplication in various parts of a system, the value of the storage depending upon its amount and location. In general, all storage lessens the requirements of those parts of the system through which the supply has already passed. It is assumed that storage adequate to meet maximum consumption demands for five days plus fire flow for ten hours, is sufficient to permit the making of most of the repairs, alterations or additions incident to the operation of a water supply system. Where storage fluctuates materially during the twenty-four hours, the minimum storage maintained is used in all calculations. In no case is a rate greater than the actual capacity of the mains from the reservoir considered. Owing to the decrease in pressure when water is drawn down in standpipes, only the capacity of the top twenty-five feet is considered as effective storage, unless the standpipe is on elevated ground and fire engines are generally used.

In grading a water system deficiency charges are made under thirty-two separate headings. Briefly stated, however, the principal requirements are as follows:

The chief executive, either superintendent or chief engineer, shall be competent and qualified by experience. Employees shall not be subject to removal by every incoming political administration. Records and plans shall be such as to facilitate repairs and to permit the efficient operation of the system. Emergency crews shall be quickly available. Fire alarms, particularly in direct pressure systems, shall sound in appropriate water works quarters.

Two items are of fundamental importance and may have very heavy charges. The first is based on the normal ability of the source of supply, including impounding reservoirs, and all parts of the supply works, to deliver the required quantity to the district being considered. The second is the reliability of the source of supply. Under supply works we include intakes, suction lines, pumps, boilers, stacks, air compressors, filters or supply mains. The extent of deficiency of each part of the supply works is considered and the percentage of deficiency of the most serious is used for computing the charge. Under reliability we consider such items as frequency and duration of droughts, physical condition of intakes, danger from earthquakes, floods, forest and grass fires, ice dams and other ice formations, and silting up or shifting of channels.

Pumping capacity must be such as to allow two pumps in reserve. The deficiency charge, however, is very small for the second reserve unit and is still further reduced for small cities. In cases where both low-lift and high-lift pumps are provided and reliability of supply is dependent on both, they are considered separately, and, if necessary, charges are made for each. Boiler capacity with a reserve of one-fourth the entire capacity, and in any case at least one boiler, must be sufficient to operate the pumps and auxiliaries required. Electric transmission lines, steam piping, or gas or oil piping to internal combustion engines or boilers, shall be so arranged that a failure in any line, or the renewal of a valve, transformer or oil pump, would not prevent maintaining, in connection with storage, maximum domestic consumption for two days and fire flow for ten hours. Pumping stations and other portions of the plant shall contain no combustible material in their construction, shall be protected from exposures and have suitable private fire protection. When pumps are electrically operated the generating station supplying them should have the same features of reliability that are required in the pumping station.

Water Lines

Although aqueducts of substantial construction are not required to be duplicated, suction or gravity lines to pumping stations, flow lines from reservoirs, force mains, etc., shall be of such capacity and so laid out that no single break will prevent the delivery of the required quantity. Such lines shall be laid as not to endanger each other, and their failure at stream crossings, railroad crossings and other points where physical conditions are unsatisfactory shall be guarded against. Is connection with supply mains, there must be arteries and secondary feeders of sufficient size extending throughout the distribution system. The gridiron shall be made up of minor distributors, 6 inches or larger in diameter, connected at intervals not exceeding 600 feet and free from dead ends. These charges, however, are reduced where pressures are high. In other words, it is a certain quantity of water that is wanted, rather than a strict adherence to a rule. Pipe in unreliable condition, whether cement-lined, wood or metal, is charged for.

The distribution system shall be equipped with a sufficient number of gate valves so located that no single case of accident, breakage or repair to the pipe system will necessitate the shutting from service a length of pipe greater than 500 feet in high value districts, or greater than 800 feet in other sections.

The requirements for hydrant spacing are based on the assumption that hose lines shall not exceed 500 feet in length when laid directly from hydrants, and 600 feet in length when supplied by fire engines. The unit of measurement which has been adopted for determining hydrant spacing is the area served by each. The area required depends on the quantity of water which the fire department may be called upon to handle. In the largest cities the average area served by a hydrant in the congested district shall not exceed 40,000 square feet, but in villages where a fire flow of only 1,000 gallons a minute is asked for, an average area of 120,000 square feet is permissible. Hydrants shall be maintained in good operative condition, shall be such size and type as to deliver 600 gallons a minute with a friction loss of not over 2½ pounds, and connections to mains shall be gated.

Business Management in the Light of Economic Conditions

The Certainty of Profits and Indeed, Their Actual Amount Depends Upon Correct Judgment of the General Business Situation —A High Speculative Element

BY ARTHUR SURVEYER
Consulting Engineer, Montreal

I read, not very long ago, statistics published by Bradstreet's covering the causes for business failures and I was surprised to note that nearly 44 per cent were attributed to incompetence and inexperience or, in other words, to maladministration. I claim there are two different kinds of management, which, for want of better terms, I shall call the internal and external management. The internal management is entrusted with the production at low cost of the finished article and the rapid selling of the product. Success along these two lines is not sufficient, however, to insure the success of the enterprise. Every business is affected by a wide variety of conditions extraneous to the business itself and which, taken together, determine what is sometimes called the trend of business affairs. The external management consists in the adjustment of the purchasing and production policies of the enterprise to the economic conditions of the country, and I am convinced that a large proportion of the failures which Bradstreet attributed simply to mismanagement should be charged up against the maladjustment of business policies to external tendencies.

If, from one year's end to another, the market price of wool, cotton, iron, etc., never varied, and the whole community bought just about so much, and wages and prices were absolutely steady, we would see manufacturers and merchants earning an almost uniform profit on their business. The profits would go up and down only as they found ways of better organization on the inside of their business, or lost skill and efficiency in handling it. But, in real business life, there is an unending ebb and flow of everything; the wool crop is short and the price goes up; a big cotton crop brings a drop in the market; the metals fluctuate in price; some great fundamental swing in general conditions of prosperity causes a rise or fall in the popular demand for what stores sell; for any one of a hundred or a thousand reasons there are incessant variations in supply, demand, price, and movement of nearly everything that a manufacturer or a merchant uses or handles.

Must Watch External Conditions

For this reason a manufacturer's or a merchant's costs may rise or his prices and business fall away in spite of the finest executive management of his interior organization that he could possibly command. And for this reason, no manufacturer or merchant could be sure of escaping insolvency if he did not know how to watch and to judge the outside situations, upon which his costs and his profits really depend in the greatest measure. Every successful manufacturer or merchant has a high speculative element in his business, and while it is perfectly true to say that he must figure profits on the basis of a margin between his expenditures and his receipts, the other truth is of great importance that the certainty of his profits, in fact, the actual amount of his profits, depends upon his speculative sense and the correctness of his judgment of the general business situation. Every successful man of business must therefore be a good speculator, in the sense of being able to exercise a prudent shrewdness in the management of the business in regard to future contingencies.

The data upon which men charged with business responsibility base judgment and action varies greatly in character and are known as fundamental statistics. The most profitable method of studying the business outlook is to analyze these statistics in relation to the different phases of trade cycles.

Four-fold Financial Cycles

All financial history has consisted of distinct cycles, and, although of different duration, each cycle has consisted of the four following periods: First, a period of prosperity characterized by high prices, and strikes for higher wages, followed by a reaction marked by a decline in business, scarcity of credit, drastic slump in prices, numerous failures and strikes against wage reductions. The third period is that of depression and is featured by low prices and unemployment followed finally by a period of revival accompanied by easier credit and rising prices.

In order to manage a business so as to secure the minimum of losses and to make the maximum profits, it is not sufficient to be able to tell at what particular stage of the trade cycle the country is passing, but it is necessary to foresee how fast the country will pass from one stage of the cycle to another, and to estimate in advance future demand, supply, money conditions and purchasing power. In order to attempt to forecast what future conditions will be, it is necessary to make a constant study of a few well selected business indexes. The drawing of definite conclusions, however, is not an easy matter as all the different barometers point together in the same direction, and it is necessary, therefore, to weigh carefully each one against the other; those who are able to judge correctly are rewarded by rapid business success.

It is more difficult to obtain statistics covering the var ious indexes of business in Canada than in the United States. On the other hand, it has been noticed that economic conditions in the United States generally anticipate by 3 or 6 months the business conditions in Canada. In this way, it is possible by a thorough study of the American and of the Canadian indexes to form an opinion on the probable future conditions.

Business Barometers

The various business barometers can be grouped under three headings: Those referring to the business activity, to the stock market and to the banking conditions.

Amongst the important barometers indicating business activity, pig iron production is sometimes called the "basic barometer" because a period of active business development is always attended by an enlarged consumption of iron and steel products. In the same way, the unfilled orders of the United States Steel Corporation not only reflect whether business is up or down, but also foreshadow to what extent labor and transportation companies will be actively employed in the manufacturing sections of the United States for some months ahead.

The railroad gross earnings, the bank clearings, commodity prices, building permits and foreign trade statistics are also good indicators of the general business activity.

One of the best barometers is the New York market as characterized by the fluctuation of the average price of 20 industrial stocks. The ordinary business man is inclined to consider the movements of stocks on Wall Street as the result of pools and manipulation, which have no connection with the trend of business. This may be true in the case of individual stocks, but it does not apply in the case of the average prices of a number of stocks. The average quotation of 20 industrial stocks together with the average of 20 railroad stocks and of 40 bnds is published daily in most of the American newspapers. The movement of the industrial stock curve reflects the opinion of the best informed business men in the United States, of men who not only make a constant study of business fundamentals but who have at their disposal inside advanced information which helps them to forecast the future with a remarkably good degree of accuracy. It is to be noted, for instance, that this curve began to drop downwards in November, 1919, whilst the peak of the general business curve was only reached in July, 1920. In Canada, the Montreal "Gazette" has lately started the daily publication of the average price of 20 Canadian securities listed on the Montreal Stock Exchange. The value of this compilation, however, will only be felt after it has been kept up for a number of years and published from time to time, in graphic form.

The factors to be considered when appraising are the reserves, deposits, the rate of commercial paper, the percentage of loans to deposits and the percentage of reserves to loans. The combination of all these data is used to calculate the index of loanable funds and it is noticeable that the rise and fall of this index are also always in advance of the actual business movements. Crop conditions and probable legislation must also be carefully followed as they have an important bearing on business conditions.

Distribution of Statistics

The average business man, of course, has neither the time nor the disposal to collate the statistics necessary to enable him to work out these indexes and it is for this reason that, in the last few years, a number of companies have been formed which, for a fee, supply the business men all the necessary statistics and even, in some cases, attempt to inform him of the future prospects, both in the country and in his particular trade. The American and Canadian governments also compile statistics of similar nature. The United States Department of Commerce, for instance, publishes a monthly survey of current business, and the Federal Reserve Board a series of publications touching upon the banking conditions. To this can be added the statistics collated by the Labor Bureaus of the United States and of Canada. Some of the Canadian banks also print and distribute every month very valuable letters in which the economic situation of the moment is reviewed and very ably commented upon.

This dissemination of business information serves a very useful purpose and, if sound advice is given and followed it will tend to make prosperity less blustering and depression more bearable.

A Period of Readjustment

We are at present passing through a period of readjustment, but there are no apparent signs of an immediate and complete revival of business activity. It is true that the index of Canadian prices has fallen about 26 per cent below the peak of May 1920, but it is still about 67 per cent above the average of 1913 and 1914, whilst the American index is only 25 per cent above the pre-war level. The fall in prices, however, both in Canada and in the United States has not been the same in all commodities and the spread between these prices is such that it has created serious inequalities.

Of all the industries, agriculture has undoubtedly suffered most and the average price for farm products is probably not more than 30 per cent above the 1913 prices compared with a general increase in the cost of other commodities of over 67 per cent. This has greatly lessened the purchasing power of the farming community, and it is important that it should be restored as soon as possible. This can be brought about either by a proportionate reduction in the prices of other commodities, by an increase in the prices for agricultural products or by larger crops. The distribution of an increased production from the farm is, however, a difficult problem since the Fordney bill has so reduced our exports to the United States that it will be necessary to develop new markets.

It is a well known fact that in a trade cycle the prices of raw materials always come down long before the cost of the manufactured articles. This comes from the fact that organized labor always fights against a reduction of wages even after the cost of living has gone down. The cost of the manufactured articles is, therefore, still high on account of high wages which are now out of proportion with the reduced cost of living and also on account of soft coal which is nearly 100 per cent above the 1913 prices. This is also due to the high wages now received by the miners in virtue of an agreement passed with the American Government and which only expires in April this year. In 1921, the output of bituminous coal was the smallest since 1911 and entailed a large amount of unemployment. It is to be hoped, therefore, that the miners will agree to lower wages during the coming year and this seems probable as in the non-union fields, wages have already been reduced and, in some cases, cut down to the 1917 level.

Favorable Signs

There are, however, a few favorable signs on the economic horizons. The banking situation has improved and the note circulation as well as the current loans without too great a reduction in the savings deposits. The balance of trade is once more in our favor and the premium on American money has fallen in twelve months, from 10 per cent to about 5 per cent. The reduction in the prices of the following staple materials, wheat, oats, corn, sugar, copper, silver, rubber, wool, leather, paper and lumber, has been very drastic and it is probable that in almost every case the bottom has been reached. The recent reduction in the cost of building materials, and notably in brick, steel bars and structural steel together with the more reasonable attitude taken by the men employed in the building trades is bound to stimulate construction during the coming months. One of the most favorable signs has been the rise in the bond market both in the United States and in Canada. Something like $120,000,000 of new bonds were sold in New York during the past week without any difficulty. This achievement speaks well for the vitality of the investment market when it is considered that this flow of new securities has been going on with little interruption for the past year, accompanied by one of the greatest advances in bond prices ever recorded in so brief a period. In Canada, both the government and municipal bonds are selling several points higher than 12 months ago, and the 5½ per cent interest coupon has once more appeared on the scene. This means that in the near future the investors who are no longer satisfied with the reduced return offered by public securities will once more give the help of their funds to the better class of industrial and commercial enterprises.

The conclusion, however, which I would like to impress upon you is the necessity for a fuller understanding by the business men of the basic economic principles. We have entered upon a business period which is essentially different from the one included in the last decade,—a period which will demand far more business sagacity, based upon accurate information and knowledge than has been demanded in the past, and to quote a well known American authority:

"The period from 1900 to 1920 was one in which, because of exceptional market conditions, it was comparatively easy to operate a business successfully. It was one of the great upward swinging business cycles; the man who 'sat tight' and managed with passing ability was reasonably sure of a profit."

"The next swing, which may be of even longer duration, will be characterized by opposite conditions. During it profits will go only to those who manage with exceptional ability. The merely passingly capable business man will find it difficult merely to carry on. 'Let's go' will replace 'sit tight', and the earliest to market will make all the gains."

Nineteen twenty-two isn't going out of its way to bring prosperity to anyone, but it will reward in a splendid fashion the fellows who go out after business.

Nineteen twenty-two is going to be like the years that have gone before it—full of opportunities for those who think of other things than the comic supplements, clocks and charity.

The loafer is going to find life full of difficulties; the worker is going to accept the difficulties as part of the job, lick 'em to a standstill and come out on top.

Don't get the idea that 1922 is going to shower you with sunshine and a soft time. It isn't. You'll work hard for everything you get. But you'll get plenty if you work.

It's always been that way and always will be.—Tom Bentley at the convention of the Associated General Contractors of America.

Trade Incorporations

Patterson Construction Company, Limited, with head office at Belleville, Ont., capital $40,000 to conduct a general contracting and engineering business.

Mainly Constructional

East and West—From Coast to Coast

Fire losses in Canada during the week ended February 1, are estimated by the Monetary times at $1,163,000, compared with $944,600 the previous week.

A by-law to provide for a temporary loan of $660,000 to apply, under the Highways Improvement Act, on road work during 1922, was approved at a recent meeting of the York County Council.

There is a report current to the effect that the manufacturing plant of the Asphalt Block Company, at Walkerville, Ont., will shortly re-open. The plant has been closed for several years.

The Eighth Annual Conference of Ontario Road Superintendents will be held for two days, Feb. 27 and 28th, just prior to the three day session of the Ontario Good Roads Association, March 1, 2 and 3. Both these meetings will be held in Toronto.

It has been announced that the sum of $400,000 has been provided for the remodelling of the old Board of Trade Building, at Toronto, to house the offices of the Toronto Transportation Commission and the Toronto Hydro Commission, instead of going ahead with the construction of a new office building. The latter project was considered too expensive at the present time.

An Ottawa report states that steadily mounting wage demands of men, for whom work has been provided by the Government, in Ottawa, to relieve their distress, have led to the discontinuance of the work and a hundred men who have been receiving $4 a day will again be jobless. The work being closed is the construction of a retaining wall along the Rideau Canal. The wall has been erected as far as the Grand Trunk bridge at Ottawa East. It will be carried no further now.

Personal

Mr. David W. Johnston, of New Westminster, was appointed municipal engineer of South Vancouver, succeeding Mr. F. J. Whittaker, who, as reported in a previous issue of the Contract Record, has taken over the position of city engineer of Prince Rupert, B. C. Mr. Johnston's early engineering experience was gained in Scotland. He has been in Canada for the past fourteen years, however, six years of which time he occupied the position of city engineer of Point Grey and three years as city engineer of Saanich, B. C. Mr. Johnston went overseas with the Canadian Engineers and since his return, has been connected with the provincial public works department, of British Columbia, in charge of road and sewer construction.

Obituary

Mr. John H. McComb, member of the firm of J. H. McComb, Limited, roofing supplies, of Montreal, died recently in that city in his 63rd year. Deceased had been a citizen of Montreal all his life.

The death of Mr. Peter Thompson, former city engineer of Peterboro, Ont., is reported at Cleveland, Ohio. Mr. Thompson occupied the position of city engineer of Peterboro for fifteen years, retiring three years ago and going to Cleveland. Mr. Thompson received his engineering education in Toronto.

CONSTRUCTIONAL ACTIVITY

Period of February 8 to February 14, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Burnaby, B.C.
Construction of waterworks extension costing approximately $10,000 is contemplated by Council. E. Smith, Engr., Burnaby.

Calgary, Alta.
City is doing grading work costing $9,750 under supervision of City Engr. Craig for Prov. Govt., Dep. Pub. Works.

Contrecoeur, Que.
Town Council plan repairs to macadam road. S. Cormier, secy.-treas.

Hamilton, Ont.
Construction of driveway on Bay front from St. Catherine St. S. to Wentworth and Burlington intersection is contemplated by Harbor Bd. and City Council.

Suburban Area Cmsn., County Court House, will construct 2½ miles of permanent road.

Hensall, Ont.
Construction of concrete pavement at cost of $25,000 is contemplated by Huron County Council. Roy Patterson, Engr., Goderich, Ont.

Kitchener, Ont.
City Council will construct sanitary sewers on several streets at cost of $30,000.

S. Shupe, Engr., will call tenders May 1st to close May 15th for construction of 2 miles of concrete sidewalks to cost $12,000 for City.

Tenders will be called May 1st and close May 15th for 55,000 sq. yds. asphalt and 12,000 sq. yds. Tarvia pavements estimated to cost $290,000 for City. S. Sharpe, Engr.

Plans will be prepared for 2 trunk storm drains to cost $33,000 for City.

St. Thomas, Ont.
Construction of pavement on Wellington St. is planned by City Council. W. C. Miller, Engr.

Sault Ste. Marie, Ont.
Construction of extension to pumping station costing $12,000 is contemplated by City. W. L. McFaul, Engr.

Sherbrooke, Que.
City Council will pave following streets: Belvedere S. from King W. to C.P.R. Station, $11,000; Frontenac St. from Belvedere to Marquette, $25,000; Bowen W. from King E. to Council St.; Brooks from Ball to Aberdeen, $6,600; Belvedere N. from King W. to Frontenac, $25,000; Alexander from Aberdeen to King W., $31,000; Montreal St. from Dufferin Ave. to Queen St., $22,500. T. Tremblay, Engr.

Construction of trunk sewer at cost of $45,000 is contemplated by Council. T. Tremblay, Engr.

T. Tremblay, Engr., has plans and will receive tenders for 6,000 ft. of 24 in. c.i. pipe, Class B.

City Council will construct reservoir at cost of $40,000. T. Tremblay, Engr.

Wingham, Ont.
Construction of concrete pavement on Josephine St. and Diagonal Rd. is planned by Huron County Council.

CONTRACTS AWARDED

Eastview Centre, Ont.
Contract for 30 in. concrete pipe required for sewers costing $75,000 for Town Council is placed with Canada Lock Joint Pipe Co., 65 Pleasant Blvd., Toronto.

Kitchener, Ont.
Contract for reservoir costing $40,000 for City is awarded to Horton Steel Co., Bridgeburg, Ont.

Montreal, Que.
A. Thezand, 885 St. Catherine St. E., is awarded general contract for construction of sewer on Roslyn Ave. for City.

Orillia, Ont.
General contract for road roller and scarifier costing $7,050 for Town is awarded to Sawyer-Massey Co., Ltd., Wellington St. N., Hamilton.

Pelee Island, Ont.
Contract for sewer and pipe culverts required for dreging Curry Marsh at cost of $12,000 for Pelee Twp. Council, is placed with Peekey & Wood, Amherstburg, Ont. Alex. Baird, Engr., Leamington, Ont.

Point Grey, B.C.
Ratepayers passed by-law authorizing road paving and general street improvements costing $200,000 and also by-law for $300,000 for extension and additions to sewerage. W. B. Greig, Engr., Municipal Hall, Point Grey.

West Kildonan, Man.
General contract for construction of sewers and watermains for Council is awarded to Thos. Jackson & Sons, 370 Colony St., Winnipeg.

Railroads, Bridges and Wharves

Ottawa, Ont.
Construction of viaduct on Bronson Ave. is contemplated by City. A. F. Macallum, Commr. of Works.

Renfrew, Ont.
Construction of bridge is contemplated by Town Council. John R. Stewart, Engr.

St. Thomas, Ont.
Construction of bridge at cost of $100,000 over Stalter Gully is contemplated by Elgin County Council. Mr. Bell, Engr., Court House, St. Thomas.

CONTRACTS AWARDED

St. Michel de Bellechasse, Que.
J. Raoul Boullanger, Montmagny, Que., is awarded general contract for repairs to wharf costing $18,600 for Dom. Govt., Dept. Pub. Works.

Public Buildings, Churches and Schools

Calgary, Alta.
Erection of convention hall to cost $143,000 is contemplated by City. E. L. Richardson, Mgr. Exhibition Bd.

Crediton, Ont.
Rev. R. A. Brooke, Pastor Methodist Church, has plans and will receive tenders until Feb. 24th for erection of church to cost $20,000. J. Vicar Munro, architect, Bank of Toronto Bldg., London.

Edmonton, Alta.
Erection of school is contemplated by Edmonton Pub. School Bd. Wm. Rae, Chrm.

Fergus, Ont.
Erection of Sunday School costing $10,000 is planned by St. Andrews Church Congregation.

Fort Garry, Man.
Erection of church is contemplated by United Church, Fort Garry. Alex. Baird, Chrm. Building Committee, 301 Huron Erie Bldg., Winnipeg.

Glenboro, Man.
R. B. Davidson, Glenboro, secy.-treas. Glencove S.D. No. 205, will receive tenders until March 1st for erection of school. Plans with F. H. Mitchell, Glenboro, and Dept. of Education, Winnipeg.

Goldstone, Ont.
Plans wil be prepared for school to cost $15,000 for Trustees S.S. No. 6. Ralph Close, secy.

Hafford, Sask.
Erection of addition to school is contemplated by Hafford S.D.

Halifax, N.S.
S. P. Dumaresq, architect, Royal Bank Bldg., is preparing plans for addition to orphanage to cost $200,000 for St. Joseph's Orphanage, Quinpool Rd.

Erection of orphanage is contemplated by Protestant Orphanage, 2 Barrington St. S. M. Brookfield and G. L. Stairs, Directors.

Harriston, Ont.
Erection of exhibition bldg. is contemplated by West Wellington Agricultural Society. J. M. Young, secy.

Hythe, Alta.
Erection of school is contemplated by New Glass Lake S.D. No. 3785. A. J. Mantle, secy.-treas., Hythe.

Ingersoll, Ont.
W. G. Murray, architect, Dominion Savings Bldg., London, will prepare plans for parish hall to cost $7,000 for St. James Anglican Church Congregation.

Kamloops, B.C.
H. Whittaker, architect, Pub. Works

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Bonds Instead of Marked Cheques

Within recent years there has been a growing tendency to demand surety bonds instead of marked cheques as security on construction contracts. There are still some municipalities, government departments public bodies and private corporations or individuals, who have not yet been convinced of the value and advantages of a bond from a surety company, but their number is gradually diminishing. The age-old precedent that demanded a money guarantee is hard to overcome, but the influence of well-satisfied contractors and owners is surely turning the trend of opinion in favor of contract bonds instead of cheques or cash. The bonding companies, too, have been very active in fostering the recognition of their bonds and in inducing their acceptance by the parties to a contract.

Contracting is often so hazardous that it is essential for owners and promoters to have some protection to guard against possible inability of the contractor to carry out his agreement. Marked cheques give no guarantee other than an expression of the good faith of the contractor when he signs his contract. They offer no criterion of the contractor's reliability or experience; they give no indication of whether he has too many contracts on hand in proportion to his financial resources and practical ability; and they cannot compensate the owner for loss experienced through failure of the contractor to carry out his agreement. From the contractor's viewpoint a marked cheque ties up money that should be employed as working capital and does not give him that confidence that a corporate surety bond will give.

Contract bonds issued by a responsible bonding company overcome these objections, for, being issued by firms with strong financial backing and after careful investigation of the contractor's resources and ability, they offer the maximum protection to the owner and permit the contractor to use his financial resources solely for his business development. Indeed, as expressed in a recent article in this journal, "it is creditable to the contractor to be able to furnish a corporate surety bond and it should, and very often does, pave the way for preference to such contractor in his particular line of work."

Because the Contract Record wishes to draw the advantages of contract bonds to the attention of our readers, it has undertaken to publish a series of brief articles on the subject. The first of these appeared in last week's issue; the second is published in this number. Others will be printed from week to week. In this way, contractors may the better understand the whole problem of bonding. We commend, therefore, to our readers, this series of articles written by a well known authority on the bonding of contractors.

Conference of County Road Superintendents and Engineers of Ontario

The eight annual conference on road construction for county road superintendents and engineers will be held in Toronto on Monday and Tuesday, February 27 and 28. The accompanying programme gives an outline of the subjects which will be discussed at the conference. Each subject will be introduced by a short address by the speakers whose names are shown on the programme, and the meeting will then be open for discussion.

MONDAY, FEBRUARY 27th

Morning Session

10.00 a.m.—"Road Drainage," by Geo. McCubbin, county engineer of Lambton. Discussion introduced by U. W. Christie, Dufferin county engineer, and J. G. Cameron, county engineer of Stormont, Dundas and Glengarry.

11.00 a.m.—"The Beautifying of our Highways," by H. J. Moore, forester, Department of Public Highways.

Afternoon Session

2.00 p.m.—Address by Hon. F. C. Biggs, Minister of Public Works and Highways.

3.00 p.m.—',Concrete Bridges and Culverts," by W. J. Moore, Renfrew county engineer. Discussion introduced by John Young, Wellington county road, superintendent, and W. J. Kean, Ontario county engineer.

TUESDAY, FEBRUARY 28th

Morning Session

9.30 a.m.—"Concrete Road Surfaces," by L. A. Pardo. Kent County road superintendent. Discussion introduced by L. S. Lichty, Waterloo county road superintendent.

11.00 a.m.—"Gravel and Stone Road Maintenance," by Frank Pineo, Elgin county road superintendent. Discussion introduced by R. H. Fair, Frontenac county road superintendent and S. Fox, Hastings county road superintendent.

No. 80

Canada's Engineers—Arthur St. Laurent

Announcement of the appointment of Mr. Arthur St. Laurent, B. Sc., M. E. I. C., to the position of chief engineer of the Department of Public Works of Canada will be gratifying to his many friends in the engineering profession and among the general public.

Mr. St. Laurent was born at Rimouski, P. Q., in 1859. He graduated from the Ecole Polytechnique, Montreal, in 1885, and for three years was engaged on the location and construction of the Temiscouata Railway. He entered the services of the Department of Public Works of Canada in 1888 and until 1898 was assistant engineer in the district office at Winnipeg. In 1900 he was entrusted with the construction of a bridge over the Saskatchewan river at Edmonton. At this point the river has a swift current and is subject to rapidly developing flood periods and Mr. St. Laurent proposed the use of concrete for the piers. This occasioned many prophesies of disaster and it required clear-headed determination and much engineering ability to obtain good work in a mentally hostile environment. When spring came, with its sweeping, ice-laden current, ordinary structures in the valley were swept away. The piers, however, withstood the test and it is recalled that the old "Northcote," a steamboat of Northwest Rebellion fame, was completely wrecked against one of them. After this experience the public attitude changed and the young engineer received the credit due him.

Returning to Ottawa, Mr. St. Laurent designed the lock and dam at St. Andrews, in the Red River north of Winnipeg, and in 1902 constructed the Laurier Avenue bridge at Ottawa and the Government grain elevator at Montreal.

He was also entrusted with the investigation of the feasibility of the Georgian Bay route via the Ottawa river, and known as the Georgian Bay Ship Canal.

Mr. St. Laurent was appointed Assistant Deputy Minister of Public Works in 1908, and in this capacity has been connected with extensive navigation problems and with our Canadian harbors and dry docks. Since the creation of the Dominion Power Board he has been vice-president of that board.

Mr. St. Laurent is a member of the Engineering Institute of Canada, of which he was for three years vice-president, a member of the American Society of Civil Engineers, a member of the International Congress of Navigation, and is the technical representative chosen by the deputy ministers as a member of the Civil Service Board of Hearing and Recommendation. He was chairman of the Ottawa Branch of the Engineering Institute of Canada in 1914.

Mr. A. St. Laurent

Afternoon Session

2.00 p.m.—"Bituminous Road Surfaces," by Alan K. Hay, engineer to Ottawa Suburban Road Commission. Discussion introduced by G. Marston, Norfolk county engineer, Wm. Watters, Lanark county road superintendent.

3.30 p.m.—"The Early Preparation of County Road Programmes," by Frank N. Rutherford, Lincoln county engineer. Discussion introduced by E. L. Miles, Victoria county engineer and N. L. Powell, Peel county engineer.

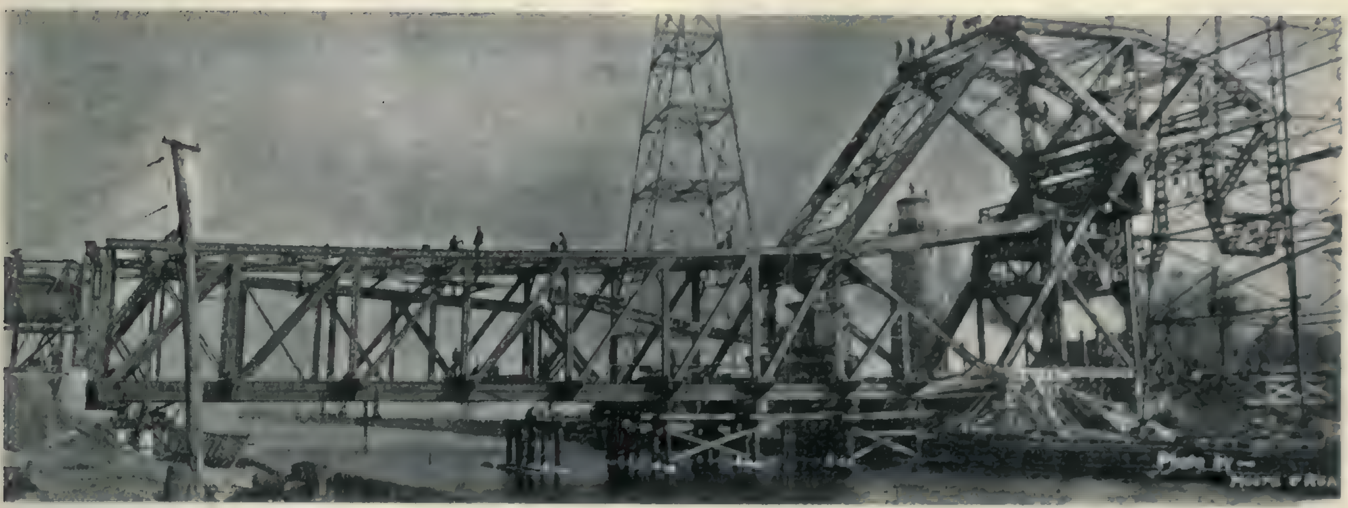
Corrosion of Underground Pipe

Owing to the loss from corrosive action of the soil in certain districts upon the material of which pipe is made in underground pipe systems, the U. S. Bureau of Standards has recently undertaken an extensive investigation of the subject with particular reference to the corrosive action of soils on gas and water mains.

In this investigation, the Bureau has the co-operation of the Bureau of Soils of the Department of Agriculture, the pipe manufacturers, and the public utility companies through the Research Sub-Committee of the American Committee on Electrolysis. Forty locations have been selected representing different kinds of soils and at each locality a number of samples of every kind of iron and steel pipe in commercial use will be buried. Complete data on the physical and chemical properties of the soil and the pipes will be obtained and extensive laboratory experiments will be conducted to determine the effects of variations and individual characteristics of both soils and pipe materials. Some tests of representative pipe coatings will also be made.

The results of the tests should be of great value in selecting the kind of pipe best suited for use in any particular soil. It is expected that considerable data on the relative rates of corrosion of the different kinds of pipe in the soils under observation will be obtained within a few years, but the investigation will probably continue over a period of ten years.

The Ontario Department of Public Highways has recently published a report of its activities for the year 1919. Complete statistics applying to provincial and county roads are included. An appendix gives the motor vehicle registration for that year.



The new Steel Bascule Bridge over Burlington Channel near Hamilton, Ont.

Steel Bascule Bridge Across Burlington Channel, Near Hamilton

Swing Structure Replaced by Lift Span—Provision for a Second Leaf in the Future—Methods of Erection—Bridge is 160 Feet Long from Centre of Bearing to Centre of Main Trunnion

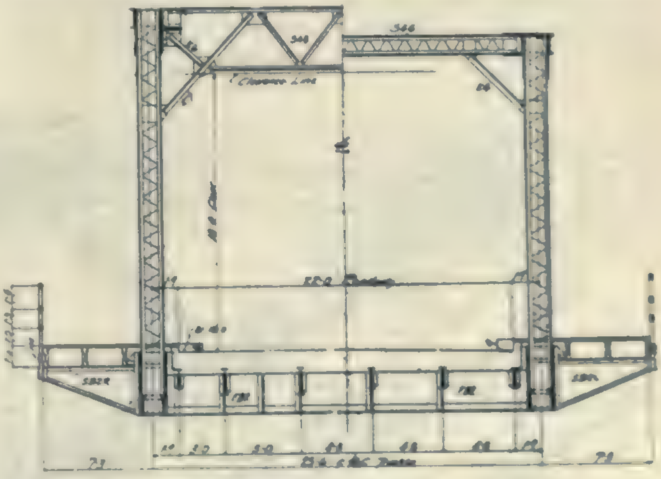
The old highway swing bridge, about nine miles north-east of Hamilton, across the channel that cuts through the narrow strip of land providing a short cut from Hamilton to Burlington, has been replaced by a fine new steel bridge of the bascule type. The decision to use this type was arrived at only after a very careful investigation, by the bridge experts of the Department of Public Works at Ottawa, of many different types of swing and lift bridges. The new bridge was built in such a position that another canal could be built in the future and a second bascule, facing the opposite direction, would span across the new canal leaving a narrow pier between them. This future extension would not affect the existing G. T. R. swing bridge, shown on the far side of the new bridge in the accompanying photograph, as it now swings on this future pier.

The foundation work involved in the new bridge was unusually intricate and demanded special methods. An article descriptive of the foundations appeared in the Contract Record of February 8, page 125. In the present article only the steel superstructure is described.

The distance from centre line of bearing to centre line of main trunnion is 160 ft. 6 ins., leaving a clear channel of 130 ft. 7 in. It is 75 ft. from the top of the concrete sidewalk to the top of the rocker bent and the total width of the bridge between handrails is 40 ft., which provides two 6 ft. sidewalks and a 22 ft. roadway with a single track radial crossing.

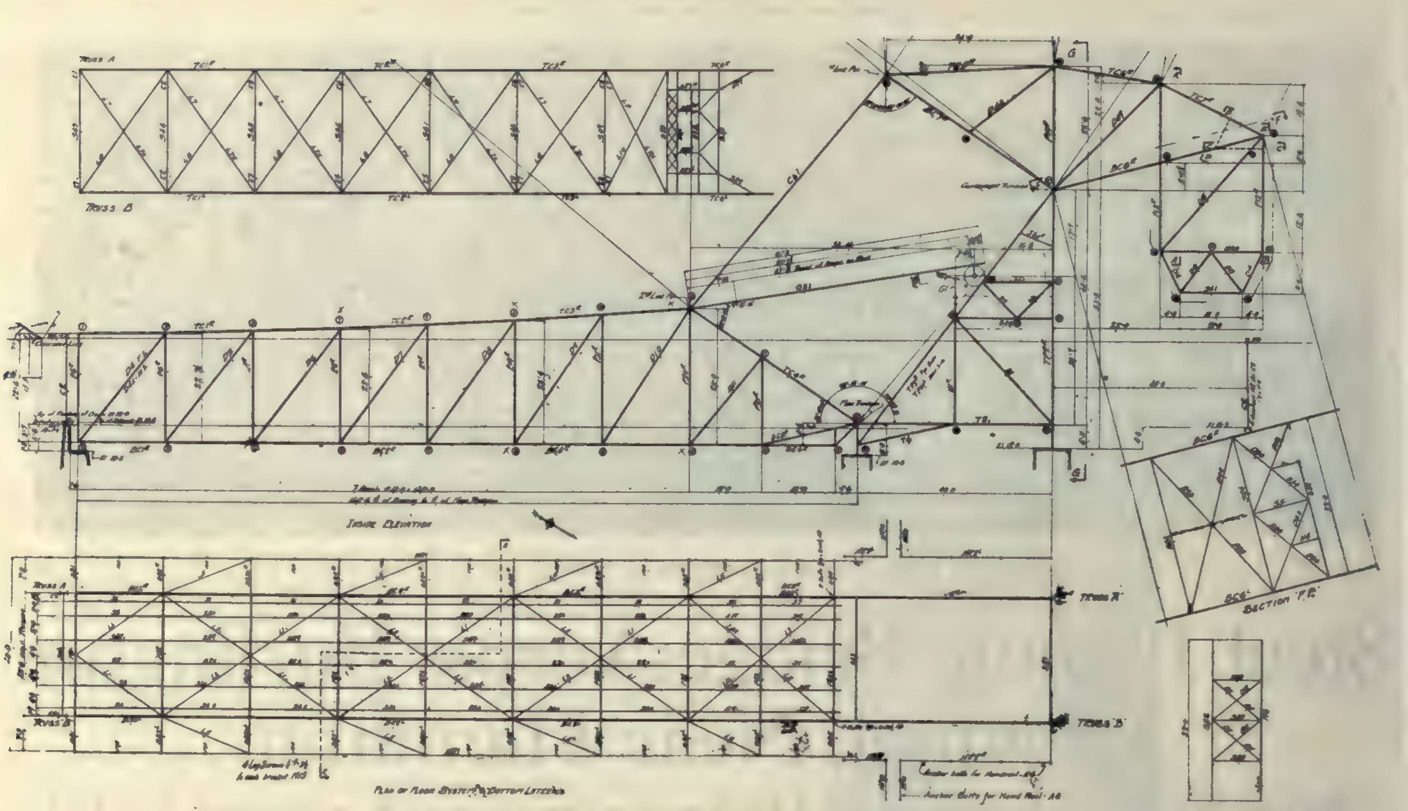
Method of Erection

The towers, the triangular shaped trusses resting on the main trunnion pier at one end of the base and on the counterweight pier at the other end, were erected first. It was thought advisable not to use guy wires in the erection on account of all the high tension electric wires at the site, so that a mast was erected about ten feet from the tower on the side away from the canal. This was held in place by a pin at the bottom and a strut from each tower at the top. A 90 ft. boom was then swung from this mast. The bottom chord of the rocker truss was erected on falsework in a lower position than shown in the photograph and then raised to its present position by means of the mast and boom. In this manner it was only necesary to lift part of the weight of the bottom chord with the boom as one end was fastened into the counter-weight trunnion. This bottom chord weighed 30,000 pounds. The rest of the rocker truss was then erected.



Section of Bridge

The moving leaf was not commenced till after navigation ceased, when piles were driven in groups of five or six across the canal. The truss was then



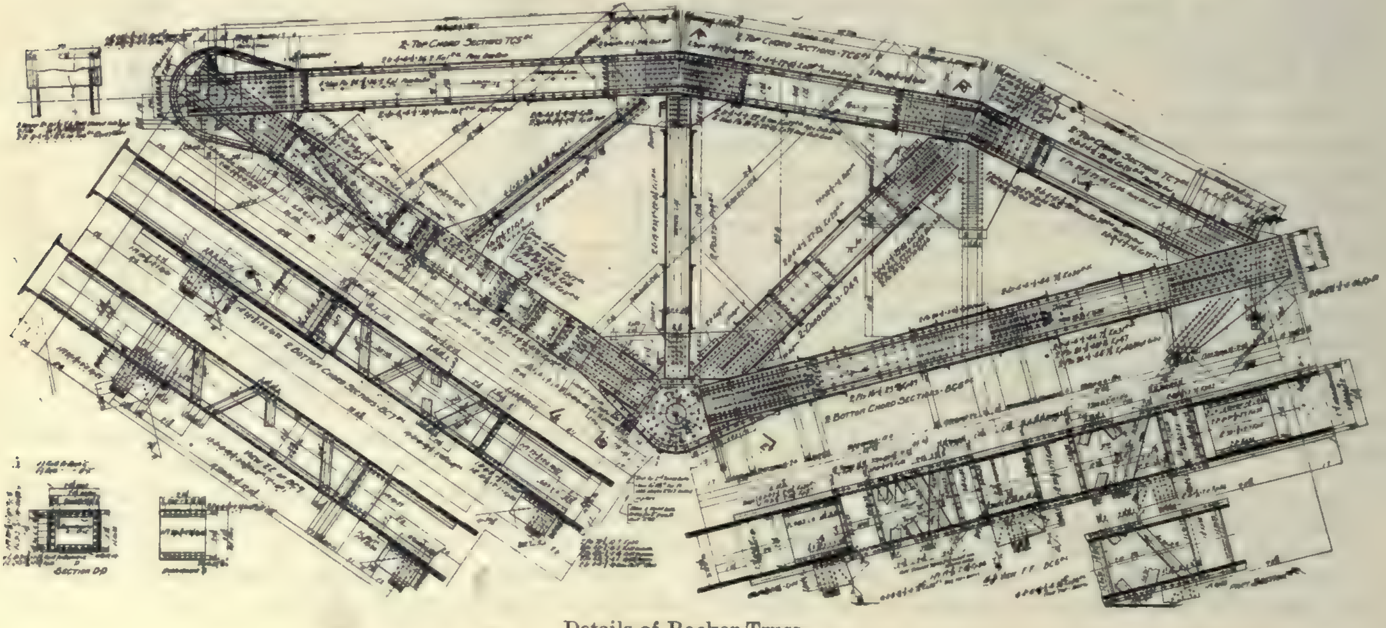
Erection Diagram of the Burlington Bascule Bridge

erected on these piles and the piles removed after the erection was complete. All that was necessary then was to put in place the link between the rocker truss and the moving leaf. This was placed and the pinion connected to the second leaf pin. The counter-weights are to be made of concrete and will be far enough apart to come down outside the sidewalks.

Due to the Strauss bascule bridge principle which is, briefly, that the algebraic sum of the moments of the moving leaf about the main trunnion shall equal the sum of the moments of the counterweights about the counterweight trunnion, great care had to be taken that the pins on each side of the bridge were at exactly the same elevation and were absolutely level. Unless this condition obtained there would be binding and the bridge would not operate. All that is required of the machinery in a bridge of this type is to overcome the friction between the different parts, as the structure is balanced perfectly. Electrical equipment with an auxiliary gosoline engine has been installed.

Work was started on the concrete piers sometime in December, 1920, and completed about the first of September last. The steelwork, weighting approximately one million pounds, was erected in less than three months.

The bridge was designed by the Department of Public Works of Canada and the steelwork was erected and fabricated by the Hamilton Bridge Works Co., Limited.



Details of Rocker Truss

Contract Bonds for Construction Work

The Second of a Series of Articles Dealing With Contractors' Guarantees--The Bond Company's Function and the Methods of Their Operations

By A. E. KIRKPATRICK
General Manager, United States Fidelity and Guaranty Co., Toronto

There was a period in the growth of this country when communities were very small indeed, travel was difficult, and the members of communities knew, or at least thought they knew, every phase of the character, habits, worth and ability of every other member of the community. In reading the fiction of the Victorian era one cannot help but be struck with the number of authors who, in developing the plot of a novel, brought into prominence the downfall of some exemplary citizen of unquestioned worth and probity, who, crashing down to ruin and dishonor, drags with him to suffering and want many faithful and trusting friends and clients, cutting thereby to the very quick into the social heart of the community.

With the growth of population the social life of the community has become more and more intricate, modern methods of transportation have created more movement and change, and the close personal touch of men with one another has frequently almost disappeared. If asked to state definitely facts concerning your neighbors' private life, actions, worth or history, you would in nine out of ten cases have to admit ignorance except as to merest generalities.

As a sequence to this growth of population and rapid change has developed the bond company to whom can come the contractor, as to his bank, with full particulars as to his worth, experience, and ability, demanding in return for confidence and probity, a credit backing by which he can demonstrate to all men, friends or strangers alike, that he can and will carry out his contracts, and that his bond company on the strength of its issued bond is prepared to stand or fall with him.

One can easily imagine with what painful feelings the contractor of former days begged humbly for the loan of his friends' names as sureties on his bonds, and one can more readily realize the pride and satisfaction of the contractor of to-day who takes into his confidence his bank and his bond company, profits by their advice and experience, so freely and cheerfully given by men of expert financial training, and approaches each piece of work with a confidence unknown to his predecessors.

How zealously this confidence is guarded is best evidenced by the fact that never in the twenty years bonding experience of the writer has he heard a suspicion of a bond company having divulged a secret, or shown favoritism in any way.

Bonding companies prevent wild-catting, and the wild-catter among contractors has been known, but the wild-catter cannot furnish a surety company's bond, but the honest and reliable contractors can.

During the years of growth of surety bonding, the bond companies have passed through many vicissitudes. One strong company of today tells the writer that commencing business in 1896, their first contract bond was issued in 1898, and that in 1896 there were twenty-four other companies operating or in process of formation, of which only four are alive to-day—twenty of them have met disaster and have been compelled to retire involuntarily from business, while this particular survivor can point to hundreds of undertakings, public and private buildings, both large and small, railroads and dams, roads and canals, sewer systems and tunnels, lighthouses and wharves, which it has taken over and completed, or assisted to a greater or a lesser degree to build by cash payments under its contract bonds.

Combination Stove and Furnace

A combination stove and furnace has recently been patented, which is said to be unusually efficient. Four cold air intake portholes, six inches in diameter, make for a very rapid circulation. The cold air, being heated, is driven to the top of the stove into an intensifying drum head and then out through the top of the stove, which has an open grate. By a slight alteration of the top, it can be used as a furnace, although its primary use is as a stove to be used in one room of a house for the purpose of heating the whole floor. This stove has the same fuel capacity as an ordinary furnace, although it is only 31 inches wide and 62 inches high.

Dam on Lake Kenogami

A delegation from Chicoutimi, P. Q., waited on the premier, Hon. Mr. Taschereau, recently to further the construction of a dam at the end of Lake Kenogami. This project would entail an expenditure of $2,000,000 and would provide employment for many unemployed in the district. The premier informed the delegation that the necessary funds for this work had been voted, but that an actual start on the work had been held up owing to the fact that as yet no customers for the electric power, that would result from this development, had been found.

The Toms Contracting Company, Ltd., have been awarded the general contract and have commenced work on a factory building in Brockville, Ont., for the J. R. Baxter Co., Ltd., Montreal. The new factory will be used for the manufacture of abrasive wheels and will cost in the neighborhood of $50,000.

The report of the Commissioner of Industries & Publicity, Mr. C. W. Kirkpatrick, shows that 24 new industries located in Hamilton last year, a very creditable showing in view of the general depression in industrial development last year.

Reparation of Vancouver's Flood-Destroyed Water System

Interesting Methods of Restoring Intake Works and Mains, Put Out of Commission by Last October's Devastation—New Improvements Planned as a Result of the Difficulties Experienced

When every mountain stream in the coast section of the Fraser River watershed jumped to flood stage in less than a week at the end of last October, resulting in extraordinary damage to private and public works and railways, the city of Vancouver and the adjacent municipalities, which share a common water supply, got off extremely well, for there was no serious interruption to the service in all the area supplied by the rivers flowing into Burrard Inlet out of the range of mountains across the harbor from Vancouver. But it was merely the lucky turn of the goddess of fortune that Vancouver and her suburbs were not placed in the awkward predicament in which the neighboring city of New Westminster has been struggling for the past three months. The only difference is that Vancouver's supply mains from Capilano and Seymour rivers were kept in commission, though one or more of them were out of service for varying periods during the few weeks following the flood, while damages to intakes and to protective roadways and cribwork were repaired so that the pipes could be used with safety.

City engineer F. L. Fellowes, who has been extremely busy directing the reparation campaign he organized immediately on the occurrence of the flood, found time to so impress the citizens and ratepayers of Vancouver with the importance of an adequate appropriation for putting the supply system in a situation beyond any possible hazard, that the vote of a loan for $250,000 for waterworks purposes was approved at the annual elections. This is the more marked because every other money by-law, including some for schools, was turned down, a fate which has almost regularly met every proposal to borrow money put up to Vancouver ratepayers in the past two years.

Vital Importance of Water Supply

"When you consider that the supply mains and circulating system of a city's waterworks are as important to the life of the community as the arteries and calculating system are in carrying the lifeblood on its vitalizing mission through the human body, you have a picture of what the results would be if anything happens to those supply mains and to the circulating system" is the illuminating way the city engineer put the matter in talking of the proposals for needed improvements and additions to the water supply system. Most of the money for this work will be devoted to installing a third main from the Seymour River intake to the point where the mains carry across beneath the sea on the bed of Vancouver harbor and alterations to the Seymour intake by removing the lower intake to the upper, where the whole will be rearranged in units capable of being shut off, without stopping the flow of water into any of the mains. Simply by diverting the flow through a bypass system each main can be kept in commission, though one part of the intake may be undergoing renovation or repair.

There is to be another important change in the supply system, growing out of knowledge gained through the recent difficulties. This change is the installing of cross-overs at various points on the eight-mile course of the mains from the head-gates to tidewater. By this means the mains will be in sections, any one of which may be shut off in case of necessity, and the flow of water through it turned into one of the other mains, acting as a "booster" to the pressure, in the lower levels of the mains so that there will be no appreciable difference in the quantity delivered through the submerged mains under the harbor.

Effective Emergent Measures Adopted

When the culmination of unusually heavy precipitation accompanied by extremely mild weather, was reached in the last days of October, 1921, the organization over which city engineer Fellowes presides was not unprepared. Constant supervision has been a part of the regular care of the highly important supply mains and headworks in the mountains from which Greater Vancouver draws all of its water service.

The Seymour River lower intake, showing intake building wrecked and almost buried by gravel which came down the narrow gulch seen in the centre of the picture.

Reparation work on the Seymour River pipe lines. Where the stream flows, a roadway on the river side of the continuous stave pipe line was washed away.

Seymour River, showing 70-ft. embankment washed away, pipe lines left exposed, roadway entirely removed and only a little protective crib work remaining.

Seymour River supply mains, showing pipes temporarily supported by wire cables, after the damage by floods.

A staff of experienced, trustworthy men is kept, whose duties are to inspect the upper reaches of the rivers, Capilano and Seymour, watch over and keep in working order the headgates and intakes on each, and patrol the routes down the canyons of the two rivers along which the numerous pipe lines are laid. In the rainy season of late fall, before the cool weather caused precipitation on the upper levels to fall in the form of snow, to remain for the winter and provide natural storage for the next summer, these watchmen on the heights are more than usually alert. Reports were telephoned in at frequent intervals, and acting on them, the city engineer's department had precautionary measures well in hand. To that preparedness in great degree is due the fact that the city and adjacent municipalities suffered no interruption of water supply, and that no vital damage was sustained by the important links of the water system which were exposed to and bore the brunt of the furious power of elemental forces set loose by the accumulation of flood waters after ten days of maximum rainfall.

No precautionary measures could possibly have coped with the fury of the mountain streams, which, increased many times in volume, hurled themselves down their steep canyons with irresistible force. It was absolutely without parallel in all public or private records, from the earliest days of development in British Columbia, to say nothing of the records kept by the city's waterworks department since their first establishment.

"Heaped upon the cumbered land
Its wreck of gravel, rocks and sand,"

is a vagrant line from Scott's poems, describing a similar condition in the Highlands. It does not adequately picture the results of the force of millions of tons of water pouring down the beds of the two rivers on the North Shore. Day after day the heavy rainfall had soaked the steep clay sides of the mountains above and below both intakes, as no frost came to hold it. The earth reached the point of supersaturation, and as the rising waters swept along, great stretches of the banks became undermined, and saturated till they could hold up no weight, huge landslides into the rivers and the stream carried down hundreds of tons of gravel, enormous boulders and the trunks of great trees, six and eight feet in diameter. The upper and lower intakes of the Seymour River system were the first obstacles in the way of the flood with its burden of detritus.

Flood Buried Intake Works

At the lower Seymour intake the wash of gravel piled up till the ponds were filled and overflowing. The stream continued to wash up deposits until the intake keeper's house was almost buried. Little more than the roof remained to be seen after the flood subsided, but fortunately the house was not crushed. The men, however, forced out in the storm, lost everything they owned, as the contents of the house, removed to what looked like a safe position on the banks, disappeared with a huge landslide which tore away the mountainside below the intake leaving a cut bank over seventy feet high.

While the lower intake was temporarily put out of commission the chief danger to the system was in the undermining of the mains for some miles down stream. In a number of places the mains had to be held with wire cables anchored to trees in safe positions higher up the sloping sides of the valley. At several points the erosion of the river in flood had cut away the road leading up the valley, leaving the pipelines, which had formerly been on the inner side of the roadway, suspended above the water where it had cut a new channel.

Capilano River, Vancouver City water supply—The October freshet washed away the road, uncovered both water mains, broke up several hundred feet of 22-in. pipe and strained the 30-in. main.

To meet the situation promptly and sucessfully was a trying task. But with the loyal support of a large staff of extra men, Mr. Fellowes and his assistants, after days and weeks of strenuous effort, have succeeded in making temporary reparations which will carry until the permanent work now authorized is completed. Photographs showing the wreckage caused by the floods will give engineers and construction men some idea of the problems presented and solved in this extraordinary combat with the forces of Nature.

Uncertainty of Nature's Forces

Chief among the difficulties presented in maintaining a water supply system in a mountainous district such as that from which Seymour and Capilano Rivers flow is the uncertainty of the course of the forces of Nature. The problem is rendered more difficult by the glacial character of the surface deposits in these valleys, with sharp bare rocky slopes at various points. Timber cutting has affected the runoff to a marked degree. The streams have been known to rise twelve feet on the hydraulic grade in twelve hours. In other words flood condditions arise overnight with unusual rainfall.

Mud slides are a constant menace in these steep mountainous regions. The contour shows a tumbled confused mass of peaks, with many clay strata overlaid with a deep deposit of gravel and alluvial soils. Saturation point reached, these gravels and alluvial deposits slide forward on the clay, drop over steep cut banks into the streams and the latter, their flow of water greatly increased, at the same time undermine the banks, increasing the slides. Dry gullies, which have been water washed at some time, suddenly become flooded torrents, adding to volume of the main streams.

Under the supervision of the Vancouver City engineer's department, complete hydrometric and meteorological records are kept. Snow and rainfall gauges are constantly marked and the likely times for flood conditions are closely known. The time when frost in the higher levels may be expected is also known. Last October's high water came at the very worst point of the season, beginning at the first of the rainy season and continuing without the usual condition of snow and frost to check it. While rainfall may be normal at sea level or in the city of Vancouver, it is no criterion of what may occur in the hills, where the average annual precipitation recorded is 170 inches, compared with an average precipitation of 56 inches in Vancouver. The record in the mountains at the source of Seymour Rivers has been known to reach 200 inches in the year.

Protection Measures Adopted.

A broad scheme of protection for the supply mains is now under way at several points in Seymour Valley, notably at the location of the lower intake, and at the big slide two miles further down stream, where a 70-foot cut bank shows the effect of the flood. At the first point, a big gulch down which slides come every year, has been a constant source of danger. For that reason chiefly, the intake is being moved and combined with the upper intake where the physical conditions are better for protection, and it will only be necessary to provide for a sudden rise in the stream.

Advantage has been taken of the low water in the Seymour River, frosty weather having held all precipitation in the form of snow in the upper levels during the past two or three months. Work has been rushed on lengthy series of cribs, built in terraces up the slope of the mountain, and cut back into the underlying clay for a firm foundation. By this means if slides begin in the higher levels they will come to slope of rest on one or other of the benches before reaching the bank of the river. Filling for these cribs, which are made of heavy timber cut on the ground, is secured from the river bed, which is a mass of boulders, low water facilitating this part of the work. It is also proposed to protect the face of the crib-work at the lower level with an apron of boulders, and if time permits before mild weather raises the water in the stream, this will also be poured with concrete.

Restoration of the roadway between the pipe lines and the river is a part of the work, and in this connection an interesting bit of emergency work may be mentioned. The pipe lines, as shown in accompanying illustrations, were left suspended above the stream, with a big sag in them, and the roadway absolutely torn away. To support them effectively and quickly was urgent. Mr. Fellowes ordered 1000 sacks, made of heavy canvas, 4 feet long and of a size that two men could handle. These were filled on the ground with a 1 to 4 concrete, dry mixed. Then the gang of men started to build them up like cribbing under the pipes. In this way a pier of sacks was erected. The water soaked through and the concrete first became saturated and then soon set. Next day boulders were packed in around this pier to protect it, and the pipe lines were safe. The pier will remain as a permanent part of the fill.

Capilano River Mains Also Damaged

While Seymour River supply mains presented the most extensive problems to the engineering department, the mains on Capilano River, the oldest source of water supply for Vancouver, and still an important factor, suffered severe damage, through a storm earlier in October as well as from that which struck Seymour.

The 22 inch steel main was washed out for a distance of several hundred feet and the 30 inch main was badly wrenched and leaked seriously. The roadway in which the mains were buried was entirely washed away for some distance, as seen in one of the accompanying pictures. The direct cause of the first damage to Capilano mains is laid to the blocking of Crown Creek, a tributary of Capilano. This blocking was indirectly the result of logging operations in the upper reaches of Capilano valley.

When the second storm struck the coast, the runoff caused five small creeks in a distance of one and a half miles up the Capilano valley to become raging torrents and greatly increased the difficulties encountered in repairing the damaged water mains and restoring the roadbed. The backed-up waters of Crown Creek bursting through the barrier attacked the protecting cribwork from the rear, causing further damage. While 150 men in six gangs have been organized at Seymour River, two gangs of sixty men, all told, have been working on the Capilano repairs, under assistant city engineer E. M. Le Flufy. It has been necessary on both operations to establish camps and send in supplies to keep the men on the ground. A distance of seven or eight miles from the waterfront to each of the works made it impossible to transport such workmen daily, the more so as the work is necessarily continuing for a number of months. With roadways broken up and washed down stream in many places, the transportation of supplies and such construction materials as had to be sent in presented a considerable problem in itself. Timber, gravel and sand are obtainable on the ground, but cement, steel, planking etc. all had to be got in over the broken roads.

All told, from figures so far submitted to the City Council, it is likely that the original estimate of $350,000 presented by Mr. Fellowes when asking for the submission of the bylaw, will be required to put Vancouver's water supply service into the assured position its vital importance demands. In years to come other large problems will have to be met and solved. Among them will be that of more adequate means of carrying the supply from the sources, to the point of distribution. The present method of duplication of submerged mains on the bed of the harbor is the weak link in the system. Another problem, a large one too, but not pressing until increasing population and industrial demands strain the present supply, is that of further development and conservation of Seymour River water. Burwell Lake, a number of miles further up than the present intake works, provides a reservoir of large capacity which can be greatly developed. No actual construction has even yet been planned for this plant. Involved in its development is also the possibility of a high pressure fire service for the city of Vancouver, which with the high level source possible to establish may more than offset any advantages of a salt water pumping service for fire pressure, which other seaport cities have installed.

Clay Products Convention

Final Section of the Report of the Meeting of the Canadian National Clay Products Association

In the last issue of the Contract Record appeared a report of the meeting of the Canadian National Clay Products Association, which was complete with the exception of a reference to the last day's session. The report of that session had to be withehld owing to the early printing of the issue but for the sake of completeness it is given herewith:

The last day's session included several interesting addresses on various subjects relative to the industry. A representative of the British American Oil Company, of Toronto, told the members all about the use of lubricating oils in clay plants. An illustrated address on "The Principles of Operation of Thermo-Electric Pyrometers" was given by a representative of the A. H. Winter-Joyner Company, Ltd., of Toronto. A. representative of the International Business Machines Limited, of Toronto, explained the working of several of this company's extensive line of time and cost recording machines. Several of these machines were prominently exhibited in the meeting room, for the inspection of the delegates throughout the convention. Mr. George Booth, of the Booth Brick & Lumber Company, Ltd., of Islington, Ont., addressed the members on the subject of "Tunnel Kilns", going into some detail regarding the operation of this type of kiln in his plant.

An interesting discussion arose in connection with this last address on a question submitted to Mr. Burgess, who had charge of the question box, as to the advisability of scrapping the down draft type of kiln to install the newer tunnel kiln for burning brick. The majority of members taking part in the discussion, while admitting the good points of the tunnel kiln as pointed out by Mr. Booth, felt that, if only by reason of the enormous initial cost of substituting the tunnel kiln for the down draft type, the action was not justified. Several of the speakers submitted figures in support of this contention. Mr. Booth, however, stated that his firm had spent a large sum of money in making this move, but he felt confident that the results obtained over the old method would amply repay them for their expenditures.

The speaker at the noon-day luncheon on Thursday was Mr. J. E. Walsh, General Manager of the Canadian Manufacturers' Association. That manufacturers and others prominently identified with the business and financial life of the country should take a larger and more practical interest in the public affairs of the country, was strongly urged by him. He also expressed the view that there were not sufficient of these men in the house of commons and legislatures. Referring to the Workmen's Compensation Act in this connection, he pointed out that while the rate of compensation had been set on the inauguration of the scheme, at 55 per cent of the regular wages of the injured workman, it had now been increased to 66⅔ per cent and an effort was being made to raise it still further to 75 per cent. The C. M. A., he stated, had supported the idea of the workmen's compensation plan from its inception, but he regarded a rate of 75 per cent as too high.

The meeting decided, on motion of W. H. Freeborn, seconded by Mr. George Booth, to leave the selection of a place for next year's convention in the hands of the executive.

The last item of business, the presentation of the report of the Resolutions Committee, by Mr. W. H. Freeborn, chairman of the committee, included a number of resolutions, the most important being one confirming the action of the executive in making a strong protest against the sale of prison made brick on government buildings. No objection was raised to prison made bricks being used in the construction of purely government buildings, but it was felt that their use for such buildings as hospitals, schools, etc., would be disastrous to the commercial plants owing to the low-production cost of the former type of brick.

The president, in declaring the convention closed, asked for co-operative effort on the part of the entire membership in the acquiring of new members to make the association more representative of the industry.

Koehring Co. of Canada Organized

Announcement is made of the organization of the Koehring Company of Canada, Limited, under Dominion charter. The head office of the company will be at 105 Front St. E., Toronto, and the purpose, to handle the sale of Koehring construction type mixers, pavers, cranes, as well as other construction and industrial plant equipment, such as Whitcomb gasoline and storage battery locomotives, C. H. & E. saw rigs, pumps, hoists, etc. A complete line of this equipment will be carried in stock in Toronto.

The Taylor-Stoker Co., Montreal, have issued an interesting booklet, entitled "I See a Paper Mill," relating a triumph of this company's mechanical stokers on the occasion of a sudden heavy demand upon the power house of a paper mill.

Past Year's Progress in Sewerage and Sewage Disposal Practice

This Article Notes the Recent Outstanding Developments in Sanitary Engineering—Many Problems Investigated with the Prospect of Successful Solution

An excellent review of the past year's progress in sewerage and sewerage disposal is contained in the annual number of "The Surveyor", our British contemporary. While this article is written from an Old Country standpoint, it is nevertheless a compendium of the best ideas that have been evolved in sewage disposal practice in all parts of the world. It is reprinted herewith because it is believed that it will be of very great interest to all engineers and especially municipal and sanitary engineers.

We are undoubtedly working with a certain ideal before us. Whether this ideal will ever be attained is open to question; but we are certainly going forward, and a considerable advance has been made in the past year. Numerous workers, regarding the problem of sewerage and sewage disposal from different standpoints, living under different conditions and having very different problems to deal with, have been working hard with the object of dealing with sewage in such a manner that there shall be no such thing as pollution of rivers or of water supplies, land or air, and that this work shall be done not only in the most economical manner possible, but that the valuable constituents which are known to be in sewage shall be preserved and utilised. They look forward to the ideal condition in which there shall not only be no nuisance from the treatment of sewage, but in which the treatment shall be unattended by expense and shall possibly be attended by considerable profit. Such hopes are encouraged by successes here and there in exactly the same manner as the hope that one day flying would become a practical possibility was encouraged by a variety of experiments in balloons, flying machines, gliders, and so forth, all of which were at one time regarded as being impossible attempts at a hopeless ideal.

The work of sewage disposal has suffered from the fact that in many cases persons are anxious to take a short cut and find a sytem which will serve all cases. Thus we have advocates for various systems, each system being of considerable value, but no system being applicable to all cases. This is complicated by the fact that the work of sewage disposal frequently requires the attention of several professions, such as the chemist, the bacteriologist, the constructional engineer, the mechanical engineer, the sewage works manager, &c. The chemist having in his laboratory made a certain discovery is apt to apply it under practical conditions of working with some disregard to the importance of the constructional work and the mechanical requirements. The civil engineer may sometimes be extravagant without intention, owing to his adherence to certain well-known safe methods in preference to methods possessing greater merit which, in his opinion, are more or less in the laboratory stage. The mechanical engineer, on the other hand, perfects his plant in accordance with the requirements of the chemist, bacteriologist, civil engineer, and works manager, and, having done so, very naturally proceeds to take out patents and to push the appliance commercially, and to do everything possible to convey the impression that the method which uses this appliance is not only the best, but that anybody else who attempts to achieve the same result by other means is hopelessly in the wrong.

Patented Processes

On the other hand, civil engineers and the public generally have sometimes a very great dislike to put themselves in the hands of firms supplying patented articles, and thus an unfair prejudice arises against some of the very best methods in existence. It must be remembered that local authorities and private persons cannot possibly spend money on experimental work to the same extent as the large commercial firm, and cannot possess the knowledge of the merits and possibilities of certain mechanical appliances for a variety of conditions as is possessed by the firms who make them and have the means and opportunity of perfecting their apparatus to an extraordinary degree, both by experimental work and through the knowledge gained at a large number of works. Very wild and unjust statements are frequently made through lack of knowledge; comparisons are frequently made between crude appliances such as were used in the earliest experiments and the finished products of years of experimental work and practical application, perfected by engineers possessing unrivalled experience at their special work. No man who was hitherto unacquainted with a manufacture of pumps would attempt to make a high-lift centrifugal pump, and take its efficiency as being the true efficiency of all other pumps. Yet it is occasionally found that someone will compare the results obtained, say, by the use of a very crude form of air diffuser with those obtained by the most modern type, and very erroneous impressions result.

Sludge Treatment

During the past year a great deal of attention has been given to the subject of sludge treatment, to various methods of purification by means of activated sludge, to the use and dewatering of sludge, and to the preservation and other valuable constituents present in sewage. We have also had information which shows that the production of a useful gas from sewage sludge is a practical possibility. It is a matter of great satisfaction that those workers who have carried out pioneer work have given the results to the world freely and generously without any consideration of the question as to whether the results would or would not compare favorably with those obtained elsewhere. We need workers like Mr. Haworth, of Sheffield, Mr. Watson, of Birmingham, Dr. Fowler, and many others who tell us at once when they have something of interest to report, for it is only by the comparison of results and from discussion that we shall make progress.

When the result of some new experiment is published the practical value is often severely questioned. This, however, is entirely wrong. Any method whereby sewage may be purified or partially purified is worth studying and there is no telling when or where it may not be needed. Mr. Eric Hannaford and Mr. George Weekes described certain experimental work with straw filters at the conference held in the summer at the Institution of Civil Engineers. It was found that a straw filter retains the nitrogen in solution which is present in sewage and which is wasted in ordinary methods of treatment. This affords a new field for valuable research work. Dr. Fowler, who was present at the meeting, pointed out at once that, whereas the activated sludge process saved the colloidal nitrogen, in the light of these experiments it ought to be possible to arrest the nitrogen in solution as well by bringing the liquid sewage into contact with some form of carbo-hydrate. A great deal of attention has been given by the authors of papers to sludge treatment, especially with regard to its utilization and de-watering. Mr. J. D. Watson dealt with these matters at the Folkestone Congress and also at the Institution of Civil Engineers. He emphasized the importance of separating grease from sewage, not only because grease has a separate value, but because the sludge is more acceptable to farmers if the grease is removed. The importance of removal of moisture from a sludge sold as a fertilizer is apparent. Ordinary sludge has useful manurial properties, but it has not the fertilizing power of ordinary farmyard manure. Thus any attempt to sell it at the same price must fail. However, if activated sludge could be properly dried the problem of efficient hygienic disposal of sewage would not be far from solution.

Land Irrigation With Activated Sludge

The discussion of this subject has been very general. It is admitted that the present waste of valuable material is very great. About fifty years ago the value of the sewage running to waste in this country was estimated at £16,000,000 per annum. Since then the volume has increased, and the value of money has changed. We are on this basis about £50,000,000 a year at the present time, but we are at the same time working hard in the direction of preventing this waste, and it appears that we are within reasonable distance of success. Great progress has been made. We are able now to purify the liquid to any required degree; we can also purify the sludge absolutely. Now we see before us the possibility of purifying both the liquid and the sludge without loss of the fertilizing properties which constitute their value. We have also abundant evidence as to the value of activated sludge as a fertilizer containing a high percentage of nitrogen present in such a form that it can be readily assimilated by plant life, a thing which does not occur in the use of ordinary sludge from a precipitation tank or digestion tank. The activated sludge contains 99 per cent of water, and can be readily delivered through mains. If this can be done, irrigation and fertilisation of land beyond the disposal works become possible, and all that remains is that we should perfect our methods of dewatering in order that we may be able to deal with the sludge at such times as the irrigation of the farmer's land is not required.

Dewatering Sludge.

With regard to dewatering, Mr. Howarth has obtained good results by the extraction of moisture from activated sludge by means of vacuum under a gauze strainer, and in the recently-published report of the Manchester River Authority we read that the best dewatering results were obtained by the same process. It does not appear that the certrifuge has yet given very good results for dewatering, either in this country or in America. It may be gathered, however, from his recent statements that Mr. Chalkley Hatton has a very high opinion of the centrifuge. Great efforts are being made in America to produce the sludge in a dry marketable form. There is no doubt that the demand for the dry fertiliser would be very great, and it does not seem too much to hope that a satisfactory and economical process for dewatering the sludge will soon be forthcoming.

Large Schemes

It has been a cause for regret that the large activated sludge system for Reading has not yet been installed. The Ministry of Health have, as is well known, found it necessary to withold sanction for the raising of actual loans where the expenditure has been sanctioned. Rotherham and Mansfield have had under consideration schemes for the treatment of sewage by the activated sludge method on the lines of the Sheffield work. Dr. Arden's visit to America and Mr. Chalkley Hatton's visit to England tend to show that the work of sewage disposal in this country is by no means behind that in America, notwithstanding the fact that while our work was suffering a setback during the war period very important work was carried forward in America, notably at Milwaukee and Houston. We understand that since Mr. Makepeace published his report on the activated sludge work at Tunstall in 1920 he has been able to increase his flow, and that he is now treating the whole of the sewage of the Tunstall district. This amounts to 500,000 gallons per day weather flow. So satisfactory has the scheme proved, that the Ministry of Health have sanctioned a large scheme for Hanley; and other districts, including Burslem, will probably adopt the same method. The experimental activated sludge plant installed by the London County Council at Crossness has been in successful operation for some months. Great interest has been taken in that plant by the officials of the council, both chemists and engineers.

Scientists are working hard in the endeavour to obtain a formula for activated sludge which shall show its quality, activity and capacity for purification. By chemical analysis and by microscopic observation it is hoped evidently to be able to say exactly what volume of sewage of a definite strength and quality can be purified by a sludge of a certain quality, and in what time. The subject is, no doubt, one of great attractiveness to the chemist and bacteriologist, and the future work of the engineer is largely dependent on it. Dr. Fowler's visit to England and his interesting remarks, both upon the treatment of sewage at home and in the East, will be remembered among the events of the year. It is certain that the activated sludge method of treatment is commending itself to engineers abroad.

Small Schemes

This is notably the case in Canada, where, notwithstanding the extreme cold, much progress is being made. Many works of importance are in progress, and what is perhaps more noteworthy and important to engineers in this country, a very large number of very small schemes, such as for hospitals and institutions, are being installed. It has been freely stated that the activated sludge system is unsuitable for small communities or for large institutions. The argument brought forward is that small installations ought to be automatic in working. Such an argument can only be held by those who have very little knowledge of small works. The care of a manager is always necessary on large or on small works if the best results are to be obtained. The manager is not necessarily required to devote a very large proportion of his time to the work, but his work cannot be avoided by any automatic plant yet invented. Further, it does not appear that a small activated sludge plant needs more attention than an ordinary filter plant. Mr. F. A. Dallyn, the well-known sanitary engineer of the Ontario Provincial Board of Health, who speaks from experience of many Canadian installations, said, in a discussion following a paper by Dr. Nasmith, read before the Engineering Institute of Canada, that he had found the activated sludge process most excellent for institutional plants. He mentioned a plant put in at the Guelph Agricultural College in 1917, which had been most satisfactory, also a plant at Orillia of a similar character, and another at a prison farm at Burwash, which were both giving good results. He had remodelled various sewage disposal plants on the same lines, and had found that the cost of remodelling was a minor matter as compared with the cost of installing other methods of sewage disposal. Quite small plants to deal with a flow from, say, 600 persons are now being installed in Canada.

In India work has been at a standstill owing to the great financial crisis, but works are in contemplation for large cities designed on the activated sludge principle. In Australia several schemes are going forward, including Brisbane. From the news which comes to hand it does not appear that very much work of this particular kind is going forward in Africa. Dr. Fowler, as is well known, is engaged upon a large scheme for Singapore. We also have information of a very large number of activated sludge schemes in contemplation in almost every country in the world. There can be no doubt that this new method is being taken up over the whole of the civilised world. Activated Sludge, Limited, alone have received considerably over 1,000 inquiries since 1919, and have actually installed twenty-one systems dealing in all with a daily flow of several million gallons.

It is interesting to note in the recent report of the City of Manchester Rivers Department that the diffusers which have been at work for some years show no signs of clogging or wear. This, taken together with experience elsewhere, clearly shows that the fears expressed that diffusers would become clogged up are groundless—provded the right kind of diffuser is used. So much has been made of this point that it is desirable to call special attention to the experience at Manchester.

Mechanical Agitation and Diffused Air

When it was known that Mr. Ransom, of Worcester, and Mr. John Haworth, with Mr. F. W. Hodgkinson, of Sheffield, were to read papers before the Institution of Municipal and County Engineers, describing the activated sludge processes at Worchester and Sheffield, it seemed that an exact comparison between the mechanical agitation method of Sheffield and the diffused air method of Worcester would be made, but it soon became clear that it was impossible to make any such comparison. The differences in the sewages and in other conditions made any such comparison impossible. These papers are of very great interest, but we are still left in some doubt, first, where the expenditure of energy—namely the horse-power required—is not much greater where the purification is effected by means of agitation with a paddle-wheel in a channel than where it is effected by means of diffusers; and next, as to whether a great deal of the aeration, or, at any rate, some of the aeration, which takes place in the diffuser process might not be dispensed with, provided that some other form of agitation were used. The whole matter is extremely complicated. Speaking generally, it certainly does appear that from the point of view of the purely mechanical engineer, the diffused air method possesses the advantage; but the probability is that a combination of methods will later be required. One of the most important conclusions of the meeting at which these papers were read was that if about 20 per cent of the moisture can be removed from activated sludge it will dry easily. Mr. Haworth, by means of a gauze over vacuum, gets rid of 24 per cent of the moisture almost instantaneously.

Mr. J. A. Coombs, at a meeting of the Royal Sanitary Institute held at Stoke-upon-Trent, stated, with regard to aeration, that his firm (Activated Sludge, Limited) had made investigation into nearly every method involving the use of either mechanical agitation or diffused air. As a result of these experiments it did not appear that there was any likelihood of mechanical agitation proving effective so long as it was necessary to reduce the tankage in order to make it commercially profitable. In other words, there is an extra expense involved for tanks in the processes of mechanical agitation. The comparison of relative efficiencies has not yet been made. We have exact figures of horse-power, &c., but these apply to different sewages. We still wait to hear the results obtained from two plants working under identical conditions. Mr. J. D. Watson may later on give us the results of such a trial at Birmingham.

Mr. Haworth, in his paper read before the Institution of Municipal and County Engineers, gave diagrams showing the daily variations in quality of the sewage, and the horse-power expended in its purification. These results are shown by curves, and it is possible by making a careful calculation to find out what horse-power was used per million gallons in order to purify sewage of a certain strength; but this result is not to be obtained merely by looking at the diagrams.

Mr. H. C. H. Shenton, in a series of articles, argued that there must be a greater output of energy required for the purification of sewage by mechanical agitation than by the ordinary diffused air process. In order to endeavour to make a comparison between the two methods it is interesting, but not necessarily conclusive, to compare Tunstall, where a sewage of average strength is treated, with Sheffield. In doing this there is no implication that the results obtained at Tunstall could have been obtained with Sheffield sewage.

The dry-weather flow at Sheffield, according to the diagrams, was 407,000 gallons per day from April 3 to April 30, 1921. During this period the sewage had an average strength of 6.35 parts of oxygen absorbed in four hours per hundred thousand. The brake horse-power per million gallons was 77.2, and the capacity of the aeration tanks in terms of the dry-weather flow was 21. These figures are according to calculations made from the diagrams. Comparing this with Tunstall, with the flow 360,000 gallons per day over a period when the sewage had an average strength of seven parts per hundred thousand in the four hours' oxygen test, the brake horse-power per million gallons is 22.4, and the capacity of aeration tanks in terms of the dry-weather flow is 10.4. There seems to be no question as to the evidence that the brake horse-power per million gallons is much greater in the case of Sheffield than in the case of Tunstall, and also that the capacity of the aeration tanks in terms of the dry-weather flow is very much greater at Sheffield than at Tunstall. No suggestion is made that the method adopted at Sheffield is not the most suitable arrangement for the particular conditions; but it appears that in considering the horse-power requirements and tankage the diffused air system holds its own for the present against the other methods.

Power From Sludge

There have been several instances in the past in which the gas given off by the sewage and septic tanks has been used in a small way for lighting purposes, and sometimes for power purposes. Recently gas obtained from sludge has been used for power purposes successfully in Australia, and now Mr. J. D. Watson has shown the practical possibilities of this method at Birmingham. These were described in a paper read before the Institution of Municipal and County Engineers. The gas in this case is produced from the sludge alone while it is undergoing the special form of separate digestion which has been adopted during recent years at Birmingham. It appears that 2 tons of wet sludge are capable of providing sufficient gas to run a 25-b.h.p. engine for six hours. This result may be of far-reaching importance.

Of other papers read during the year "The Maintenance of Clean Filtering Medium in Sewage Filters," by Mr. Herbert D. Bell, read before the Association of Managers of Sewage Disposal Works, is of considerable importance. The paper upon "Sewer Gas" read by Mr. H. C. Whitehead before the Municipal and County Engineers, draws attention to dangers which are apt to be overlooked, and suggests remedies which will be very valuable to those who have charge of large sewerage systems. The paper on "The Bradford Sewage Disposal Works" by Mr. Reddie, and the paper by Mr. Bolton upon "Special Experiments with Activated Sludge at Bury," read before the Association of Managers of Sewage Disposal Works at Bradford, are also of great interest. The special treatment of the sludge at Bradford and the original experiment at Bury, where a special form of mechanical agitation is used, should be noted. The report upon the industrial wastes from the Chicago stockyards and packing town provides a great deal of data which will be of considerable value to engineers who have schemes of sewage treatment by the activated sludge process under consideration. No better example exists of the thorough investigation of the question. A careful study of this report and of the results obtained at Milwaukee and at other large working installations in America and in this country ought to precede the making of fresh experiments. It is of little value to carry out work in order to reach conclusions already established, and the resources of those authorities who carry out such improvements should be devoted to fresh work. It does not appear that this is always done.

Sewerage

There has naturally been a tendency to permit work of inferior quality to be done in order to save expense. It happens thus. An engineer is not at all likely to permit any falling off in the quality of his own special work, but when he has to deal with work a little outside his experience he may fall into the error of false economy owing to lack of knowledge. Certain speakers at the Congress of the Royal Sanitary Institute held at Folkestone expressed the opinion that under existing conditions the omission of concrete as a bedding for sewer pipes was desirable on the grounds of economy. Engineers who have had much experience of sewer laying know how necessary the concrete bedding is. Experience has proved that without proper foundations cement-jointed pipes will develop leaks. It will be remembered that Mr. Palmer, of Hastings, took up the challenge at once with vigour, and showed very clearly that however great the pressure might be that was put upon them, engineers must not economise by putting in bad work. The suggestion was altogether retrograde.

The use of the concrete manhole, and especially of the watertight manhole with watertight base in which the channels are formed in cement before it is lowered into place, is perhaps the most striking development in recent work. These manholes have been made for many years past, but it is only comparatively recently that they have come into general use. They are very much cheaper than brickwork, and are generally sounder and more likely to resist the entrance of land water into the sewer or the leakage into the ground. A reinforced concrete manhole cover was exhibited in London, but as yet it does not appear to have been brought into general use.

For some time past we have heard of the possibility of laying pipes in the ground without digging trenches by means of thrusting the pipes forward through a horizontal boring. An important instance of such work exists at Norwich, where the sewers of the first portion of the Mill Cross housing scheme were laid by means of the Magnall-Irving thrust borer. It was found that local men soon became efficient, and after a few trials 6-in. stoneware sewer pipes were jointed and pushed into the bored hole. This method was found to be possible in soft soil, but in sand, gravel, and flint the borer was found to be unsuitable. But for this change in the character of the ground it is stated that the whole system, including 9 in. and 12 in. sewers, would have been laid by the thrust-boring system. The work was watched by the Ministry of Health and the London County Council. Mr. Collins, the city engineer, is favourably impressed by the method, and considers that in suitable ground great economies may be effected by thrust boring. It is evident that in order to obtain the best results special joints will be required. The operation of the thrust-boring method is limited at present to ground of a clay nature. The plant was described in our issue of June 3, 1921. It is evident that for laying iron pipes the process might very often be extremely useful. The perfection already attained by this process is clear when we hear of such delicate and accurate work as sewer laying attempted.

The Selection and Proportioning of Sands for Sheet Asphalt Paving Mixtures

BY PREVOST HUBBARD
Chemical Engineer, the Asphalt Association

Paper read before the American Good Roads Congress

Control of the character and grading of sand used in the preparation of wearing course mixtures is a very important factor in the construction of sheet asphalt pavements. Ordinarily sand constitutes from 70 to 80 per cent. of the weight of such mixtures and under compression during construction the sand grains are crowded together so as to form the skeleton structure or frame work of the wearing course. These grains take most of the wear of traffic and should therefore be of hard, sound material such as quartz. They should also be clean and free from coatings of any sort and preferably rough surfaced so that the asphalt cement will adhere firmly to them. With regard to the actual size and grading of the sand grains best suited for such work, much more has been learned from experience than from theory. Theory and practice, however, agree on the desirability of using sand with a relatively low percentage of voids when the grains are in intimate contact. Experience has shown that when certain grading requirements are met the percentage of voids may be kept within satisfactory limits without sacrificing other necessary characteristics, such as ability to carry mineral filler. Such requirements are therefore usually included in specifications.

The presence of an appreciable amount of grains coarser than 10 mesh brings the mixture into another class of construction known as asphaltic concrete which will not be considered in this article. Sand grains passing the 200 mesh sieve are considered undesirable because they tend to produce a mushy mixture and limestone dust or Portland cement are preferentially used to supply all of the very fine mineral matter which is necessary to fill the tiny voids in the sand aggregate. The first requirement is therefore, that the sand shall all pass the 10 mesh sieve and the second that not more than 5 per cent. shall pass the 200 mesh sieve. The first requirement can be met without difficulty even if the original product has some material larger than 10 mesh, by passing it over a revolving screen, with openings of suitable size, which is located over the storage bins of the paving plant. If the second requirement is met, nearly all of the material passing a 200 mesh sieve will be blown out of the sand during its passage through the drier so that for all practical purposes the sand specified may actually be considered as all passing the 10 mesh and retained on the 200 mesh sieve.

Having quite definite maximum and minimum limits for the sand as a whole, it is also most convenient in paving work to calculate the relative weights of the various size grains upon a percentage basis, which will show a total of 100 per cent. passing the 10 mesh and retained on the 200 mesh sieve. Eight standard sieves are used for this purpose, 10, 20, 30, 40, 50, 80, 100 and 200 mesh, and each percentage calculated represents a size which passes one sieve but is retained upon the next smaller sieve. There are, therefore, seven such individual sizes the allowable percentage limits of which are included in paving specifications. The following table shows the limits taken from specifications of the Asphalt Association, which are typical of good practice:

Sand Grading for Sheet Asphalt

		Per Cent.	
Passing	Retained on	Individual Sizes	Group Sizes
10 mesh	20 mesh	3 to 15	Coarse 14 to 50
20 mesh	30 mesh	4 to 15	
30 mesh	40 mesh	5 to 25	
50 mesh	80 mesh	5 to 40	Intermediate 30 to 60
40 mesh	50 mesh	5 to 30	
80 mesh	100 mesh	6 to 20	Fine 16 to 40
100 mesh	200 mesh	10 to 25	

The Three Group Method of Grading

In this table it is seen that besides the limits for each individual size the sand grains are divided into three main groups which may be designated as coarse, intermediate and fine. The coarse group consisting of 10, 20 and 30 mesh particles all of which are retained on the 40 mesh sieve, is allowed to vary between 14 and 50 per cent. Taking an average of 32 per cent., an approach toward the minimum limit is desirable for heavy traffic which tends to crush the large grains more readily than the fine. For relatively light traffic, however, a higher percentage of coarse grains is not only permissable but will produce a mixture less likely to crack by contracttion owing to the thicker films of asphalt cement which it carries. Under heavy traffic any tendency to crack is largely overcome by the kneading action of the traffic itself.

The fine group, consisting of 80 and 100 mesh particles which are retained on the 200 mesh sieve, serves to fill the large voids in the combination of coarse and intermediate groups and enables the mixture to hold, evenly dispersed, the mineral filler which is needed to fill the very small voids and give stability to the pavement. When the percentage of coarse group is relatively high the percentage of fine may be relatively low and vice versa.

The intermediate group, consisting of 40 and 50 mesh particles which are retained on the 80 mesh sieve appears to serve somewhat as a pivot for the coarse and fine groups. An average of about 45 per cent. will serve equally well for use in light and heavy traffic mixes. In the former, however, the sand may carry as high as 60 per cent. and the latter as low as 30 per cent. of the intermediate group.

When the fact that a certain amount of each individual size is specified, it is seen that the percentage limits for each size are quite broad. As a matter of fact, if in each group the individual sizes are about equally proportioned a very satisfactory grading results. The group percentages are therefore the most important and are first considered when selecting sand for sheet asphalt construction.

The use of local sand for paving work is desirable not only from the standpoint of convenience but as a matter of economy. As has been stated sand constitutes from 70 to 80 per cent. by weight of the paving mixture and a high freight rate on this constituent greatly affects the cost of the finished pavement. It frequently happens, however, that no single local sand can be found which meets specification requirements and when this happens it may become necessary to mix or combine two or more available sands of known mesh composition in order to produce an acceptable product. In such case it becomes necessary to ascertain in what proportions the sands should be used to give the desired grading. This is ordinarily done by a tryout method or by lengthy but simple mathematical calculation. The fact that there are three main groups to be considered and that the sum of these groups equals 100 per cent. makes it possible to utilize the triaxial diagram for quickly and accurately ascertaining the most suitable proportions, although to the best of the writer's knowledge the diagram has not heretofore been used for this purpose.

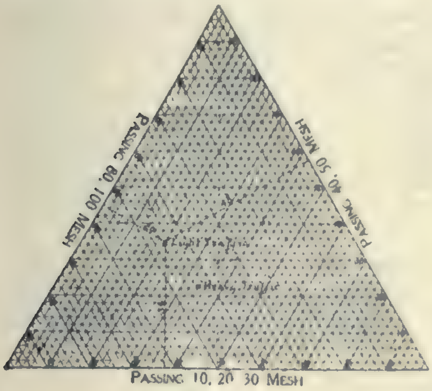


Fig. 1

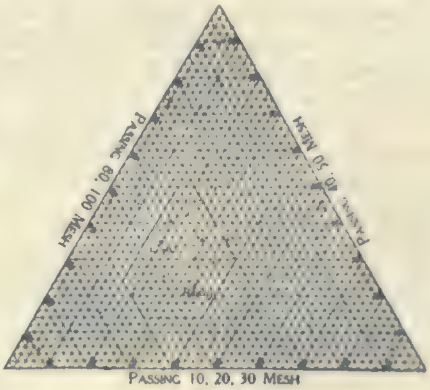


Fig. 2

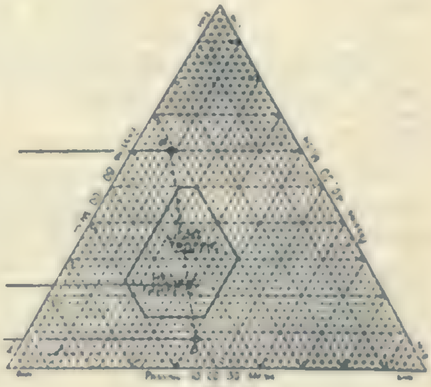


Fig. 3

The Triaxial Diagram

For those who are not familiar with the triaxial diagram it may be said that it consists essentially of an isoscles triangle in which, as is well known, the perpendicular distance from each base to its opposite apex is equal. These perpendicular distances may therefore serve to represent 100 per cent. of anything that the base line stands for. The perpendicular distances may be divided in any convenient way such as hundredths and if lines are drawn through such divisions parallel to the base lines the large triangle is divided into a large number of small isoscles triangles as shown in the accompanying illustrations. It is a simple geometrical proposition to prove that for any point within the area of an isoscles triangle, the sum of the perpendicular distances to each side is equal to the perpendicular distance from any side to its opposite apex. If the distance from base to apex represents 100 per cent. it is evident that the sum of the perpendicular distances from a point within the triangle to each side must also equal 100 per cent. When there are only three constituents of a substance it therefore becomes possible to plot the percentage composition of each constituent by means of a properly located point with in the triangle.

In Fig. 1 each side of the large triangle serves as a base line for one of the three groups of sand grains previously discussed. The distance between each side and its opposite apex is divided into 50 equal spaces by lines parallel to the base line and the distance between each line and its neighbor therefore represents 2 per cent. Within the area of the triangle the two dots surrounded by circles represent the composition of ideal sands for light and heavy traffic which conform to the following grading in so far as the three group sizes are concerned:

Passing	Light Traffic Per Cent.	Heavy Traffic Per Cent.
10, 20, 30 mesh	35	23
40, 50 mesh	45	43
80, 100 mesh	20	34

The dotted line connecting the light traffic sand with the three sides of the triangle illustrate how the position of the sand has been located to show the percentage composition given above.

Figure 2 is exactly the same as Figure 1 except that the dotted lines have been left out and a shaded area inserted to represent the percentage limitations for the three groups as covered by the specification requirements given in the first table. It is at once evident that any sand which conforms with the specification limits will fall within this shaded area if its percentage composition is plotted. On the other hand, if the sand lies outside of the shaded area it does not conform with the specifications and should only be used in combination with some other sand.

Problem I.—Use of the Triaxial Diagram in Proportioning Two Sands

Suppose two sands, a and b are available neither of which meet specification requirements and it is desired to ascertain if these sands may be combined so as to conform with specifications and if so the most suitable proportions in which they should be combined. For the sake of illustration it may be assumed that these sands show the following grading:

Group	Per Cent. a	b
Passing 10, 20, 30 mesh	60	8
Passing 40, 50 mesh	31	51
Passing 80, 100 mesh	9	41
Total	100	100

If these two sands are plotted on the diagram it is found that their locations as shown by points a and b respectively in Fig. 3, lie outside of the specification area. The grading of all possible combinations of these two sands is then illustrated by means of a straight line drawn between these two points. If their locations had been such that the connecting line did not cut the specification area it would have been impossible to combine them in any proportions so as to meet specification requirements. In the example given, however, it is seen that the connecting line passes through the specification area and that a rather wide range of combinations will prove satisfactory. It is therefore possible to so proportion the sands as to obtain a grading at any point on the connecting line wthin the specification area. If, for example, it is desired to produce a grading as close as possible to the ideal heavy traffic sand the location of such grading would be indicated on the diagram at point "c" the actual grading of this combination being as follows:

Passing 10, 20, 30 mesh	23	per cent.
Passing 40, 50 mesh	45	per cent.
Passing 80, 100 mesh	32	per cent.
	100	

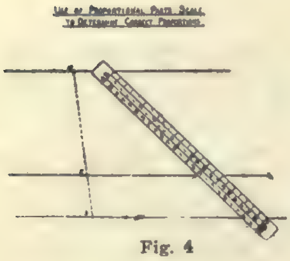

Use of Proportional Parts Scale to Determine Correct Proportions

Fig. 4

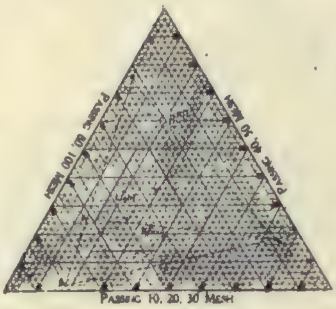


Fig. 5

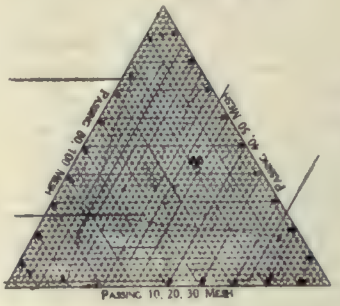


Fig. 6

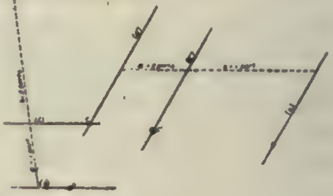


Fig. 7

The proportions required to produce this grading is, moreover, directly indicated by the relative distance of point c to points a and b. Thus, if the distance from c to a is twice the distance from c to b then two parts of sand b to one part of sand a will give the grading shown by point c. The exact proportions may be quickly and conveniently ascertained by first drawing parallel lines through the points a, b and c. In doing this any convenient base line of the diagram may be used as a guide. In Fig. 3 the 10, 20, 30 mesh base line has been used for this purpose, but either of the other base lines would have served equally as well, although it is desirable to have the parallel lines as far apart as practicable. As the lines which were drawn are parallel it follows that the relative distances between them are exactly the same as the relative distances between points a, b and c through which they pass. These lines may therefore be used equally well to determine exact proportions.

If we now forget the diagram itself it will be found that four lines have been plotted as shown in Fig. 4. By means of a special proportional parts measure also shown in the figure it becomes possible to read off at once the exact proportions in which sands a and b should be combined to produce the grading represented by c. It will be noted that the two end divisions on this measure are lettered A and B respectively. In using the measure division A should first be placed at any suitable place on the solid line passing through point a and then rotated until division B rests on the solid line passing through point b. It is seen that the solid line passing through point c intersects the measure at a division which shows the proportional parts in columns A and B to be 7 and 17 respectively. In other words 7 parts of sand a and 17 parts of sand b will give the grading of the combination represented by point c.

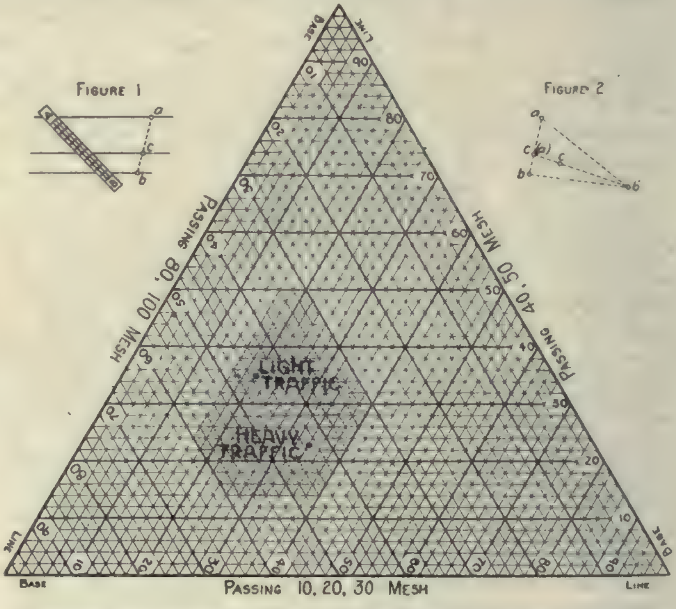
Problem II.—Use of the Triaxial Diagram in Proportioning Three Sands

If the use of the triaxial diagram for proportioning two sands is thoroughly understood its use in proportioning three sands becomes a very simple matter. In the following example it will therefore be assumed that the reader has mastered problem I.:

Suppose three sands, a, b and b' are available, no two of which can be combined to meet specification requirements, and it is desired to ascertain if the three sands may be combined so as to conform with specifications and if so the most suitable proportions to use. As an illustration it may be assumed that these sands show the following grading:

	Per Cent.		
Group	a	b	b'
Passing 10, 20, 30 mesh	74	2	18
Passing 40, 50 mesh	23	80	8
Passing 80, 100 mesh	3	18	74
Total	100	100	100

The location of these three sands in the triaxial diagram is shown at points a, b and b' in Fig. 5. It is seen that none of the lines connecting these points pass through the specififcation area so that no two sands can be combined so as to meet the specifications. By combining sands a and b, however, any grading may be obtained on line ab and if all such possible mixtures of a and b are considered, it is further seen that sand b' may be combined with such mixtures so as to produce all gradings falling within triangle abb'. As the specification area falls within this trangle, it is therefore possible to combine the three



Method for determining proportions of sands for sheet asphalt—The above diagram may be used to work out actual sand proportioning problems. The sand gradings and the ruling of necessary lines may best be plotted and drawn upon a transparent paper placed over the diagram. This makes it possible to use the same diagram for the solution of any number of problems.

sands so as to obtain any desired grading within the specification area.

Now suppose it is desired to obtain the ideal heavy traffic grading in the specification area, we may draw a line from point b' through the ideal heavy traffic grading and continue it until it intersects line ab. The point of intersection may be lettered c. The determination of the proportions of sands a and b to produce c may be readily determined as described under problem I, and if this mixture is then considered as a single product the proportions of this mixture with sand b' which will give the ideal heavy traffic mixture may be determined in a similar manner.

Fig. 6 illustrates the preliminary steps necessary to determine these proportions with one set of parallel lines drawn through points a, b and c and second set of parallel lines drawn through c, b' and the ideal grading. Fig. 7 shows these parallel lines with the diagram eliminated the lines being lettered (a), (b), (c), (a'), (b') and (c'). Now suppose the proportional parts measure shows that one part of a and 2 parts of b will produce c. Further suppose it is found by using the measure that 2 parts of this mixture now called sand a' and one part of sand b' will give the ideal grading now called c'. The direct proportions of sands a, b and b' would be obtained by multiplying the parts of a and b by the parts of a' and multiplying the parts of b' by the sum of the parts of a and b, as follows:

Parts

$\left.\begin{array}{l} a = 1 \\ b = 2 \end{array}\right\} a' = 2$

Total 3 b' 1

Direct Proportions

$\left\{\begin{array}{l} a\ \ 1 \times 2 = 2 \\ b\ \ 2 \times 2 = 4 \end{array}\right.$

b' 3 x 1 = 3

Total 9

The Proportional Parts Measure

For use with the triaxial diagram a proportional parts measure may be devised with any convenient scale of divisions. For most purposes the a scale showing all common proportions not exceeding a total of 12 parts to the mixture will be satisfactory. For the sake of convenience when actually mixing sands it is desirable to have as few total parts as possible and it will often be found that without creating much damage in the grading of a mixture one set of proportions may be as good as another. In such cases the simplest proportions should be settled. Thus in Figure 4, while the exact proportions of sands a and b are shown as 7 to 17 respectively, it is seen that the more simple proportions of 1 to 2 or 1 to 3 are quite close. Reference to Fig. 3 will further show that either of these simple proportions is sufficiently close to the desired grading to be adopted as a matter of convenience.

It should always be remembered that the triaxial diagram takes into account only the three sand groups and that the intermediate gradings are also covered in specifications. After it has been used therefore, the individual gradings should be calculated on the basis of the proportions which have been indicated in order to ascertain if such proportions will be entirely satisfactory. If not, a slight change in indicated proportions will often be found to bring the mixture within specification limits in all respects. Of course, if any individual size is missing in all of the sands the specifications cannot be met, but this would be a rare exception and in most cases the proportions determined from the group gradings alone will be found satisfactory.

A triaxial diagram with a transparent cover of celluloid or tracing cloth which may be carried in an ordinary coat pocket will often prove a considerable time any labor saving device for the contractor, inspector and engineer both when prospecting for available sands and in setting proportions for use at the paving plant. The transparent cover may be used for plotting the sand gradings and drawing the lines for use with the proportional parts measure, and when one set of determinations has been made all marks may be erased and the cover used over and over again.

If when prospecting for sands a portable field outfit consisting of a small spring balance and set of four sieves (10, 40, 80 and 200 mesh) is used, the triaxial diagram will quickly show when suitable products have been located. To those who have not been familiar with the triaxial diagram, methods here described may at first seem somewhat complicated, but with very little practice it will soon be found that its use is a very simple matter and much less tedious and complicated than any method of mathematical computation.

Bituminous Spraying & Contracting Co. to Perform an Important Service

The Bituminous Spraying Company of Canada, which operated successfully last year in the counties of Lincoln, Peel and York for several contractors, has applied for letters patent and is about to incorporate under the name the Bituminous Spraying and Contracting Company, Limited, with a capital of $250,000. The object of this company is to provide a spraying service similar to that rendered by such companies in the United States for the heating, hauling and spraying of all natures of tars and asphalts used in the maintenance of roads and highways.

The company will have three motor driven pressure distributors, with tank car heating apparatus mounted on trailers, in operation in Ontario at the commencement of the season in May next. The plant is modern in type and designed to meet the requirements of the specifications of the best practice in Canada and the United States. The motor truck distributors are equipped with steam boilers to provide the heat essential in the handling of bituminous materials and to operate the air pumps for generating a uniform pressure of 40 pounds per square inch on the material, which is sprayed under this pressure uniformally and in any desired quantity per square yard of roadway, in a strip which can be regulated from 7 inches to 10 feet in width.

This service will undoubtedly supply a long felt want among contractors who hesitate to make the necessary heavy investment for modern spraying machinery: also to municipalities, whose season's operations are too limited to warrant a large capital investment for efficient machinery in consequence of which they have been forced to purchase cheap, slow and inadequate types of apparatus which give unsatisfactory results. From many viewpoints the advent of the Bituminous Spraying Co. of Canada will be noted with satisfaction.

The highways branch of the Department of Railways and Canals, Ottawa, has recently issued circular No. 2, giving motor vehicle statistics for Canada and a summary of progress under the Canada Highways Act to Sept. 30, 1921.

Equipment Rent Agreement

The 1922 Form Offered by the Associated General Contractors for the Guidance of Constructors

The following is the 1922 form of the equipment rental agreement of the Associated General Contractors of America as prepared by that organization's committee on methods and contracts. It is here printed for the guidance of contractors who need equipment under a rental arrangement. The editor of the Contract Record would like to receive comments on this agreement with a view to improving its application.

Equipment Rental Agreement (1922 Form)

Agreement made this .... day of ...., 192.., by and between

(Name) ....

(Identification) ....

party of the first part, hereinafter called the **Owner** and

(Name) ....

(Identification) ....

party of the second part, hereinafter called the **Lessee.**

Witnesseth: That in consideration of the covenants and the payments hereinafter provided, the Owner and the Lessee agree as follows:

Article I

Material Leased: The Lessee hereby leases from the Owner for use at or near .... all equipment herein named and identified under the List of Equipment, and throughout this agreement designated in whole or in part as "Equipment." Each article of Equipment shall be delivered to the Lessee or his agent in good repair, fully equipped for operation as herein described, and shall remain in possession of the Lessee, subject to conditions hereinafter stated, for approximately the time designated in the List of Equipment as the approximate Rental Period.

List of Equipment

	Column No. 1	Column No. 2	Column No. 3	Column No. 4
Articles of Equipment	Identification Number	Approx. Rental Period	Rental Rate	Value of Article

Article II

The Rental Period: The rental period for any article of equipment shall begin on the day following legal delivery of that article to a public carrier or a carrier of the Lessee, for transit to the Lessee, or if delivered directly by the Lessor on the date of actual delivery to the Lessee, and shall continue up to and including the date upon which such article is either legally delivered to a public carrier for transit from the Lessee's work or is by the Lessee actually delivered to another lessee or to the premises of the Owner. The Rental Period shall be the only time during which the Lessee may become liable for the loss of or damage to the Equipment.

Article III

Payment: The Lessee shall pay rental for each article of Equipment named in The List of Equipment at the rates thereby indicated for each article.

Payment of rental for each month shall be made by the Lessee on or before the fifteenth of each following month at the Owner's office or such other place as the Owner may designate in writing.

Monthly rental rates shall not be subject to any deductions on account of any non-working time in the month and the amount of rent payable at the beginning or end of the Rental Period for any fraction of a month shall be the monthly rental rate, prorated according to the number of calendar days in such fraction.

Daily rental rates shall not be subject to deductions for any non-working time in the day and shall be paid for each calendar day in the month except that rental on Equipment leased at a daily rate shall not be paid for Sundays and legal holidays unless such Equipment is used on such days.

Daily and monthly rates named in the List of Equipment have been based upon the expense of operating equipment ten hours per day, and for each hour over ten during which the Equipment is **Regularly** operated, the daily and monthly rates shall be increased three (3) per cent.

The monthly payment for equipment leased on a unit of work basis shall be the number of units shown in the supervising engineer's estimate multiplied by the rate per unit.

The Lessee shall pay the Owner a minimum rental of 6 per cent of the total value as given in the list of Equipment of any equipment actually delivered to a public carrier or other agency of transit to the Lessee.

Article IV

Transportation: The Owner shall ship all Equipment f.o.b. public carrier or other agency of transportation as specified by written shipping instructions to be furnished by the Lessee, and shall make shipment on the date named in such instructions, or within five days thereafter.

The Owner shall also at his own expense unload the Equipment upon its return from the Lessee's work, but all other expenses of transportation including handling at the Lessee's shipping point, freight, switching and hauling shall be borne by the Lessee.

Article V

Returning Equipment: Except in case of cancellation of this agreement the Equipment may be retained by the Lessee until expiration of the approximate Rental Period as designated in Article I, or may at any time, upon ten days' written notice, be returned to the Owner.

After expiration of the approximate Rental Period, which period may be altered by mutual written agreement of Owner and Lessee, the Owner may at any time request release of and the Lessee shall within ten days thereafter release and return the equipment as requested, but any expense incurred thereby over and above that of shipping the Equipment to the Lessee shall be paid by the Owner.

Article VI

Maintenance and Operation. The Lessee shall not remove, alter, disfigure or cover up any numbering, lettering or insignia painted or otherwise displayed upon the Equipment, and shall see that the Equipment is not subjected to careless or needlessly rough usage; and he shall at his own expense maintain the Equipment in good operative condition, well greased, oiled and repaired and in such condition shall return it to the Owner. All tools, appliances and appurtenances shall be returned therewith in good condition

(Optional)

The Owner shall furnish the following operators for equipment subject to the following conditions: . .

Article VII

Damage to Equipment: The Lessee shall indemnify the Owner against all loss of Equipment and all damage thereto incurred during the Rental Period from fire, theft, flood or any other cause; and the appraisal of any such loss or damage shall be based on the equipment values herein named in Article I. Any public carrier transporting the Equipment to the Lessee during the Rental Period shall be an agent of the Lessee, and any such carrier returning the Equipment to the Owner shall be an agent of the Owner. Short and damage claims of either party shall be made known to the other party within 5 days after receipt of Equipment.

Article VIII

Repairs: The Lessee shall bear the expense of renewing boiler tubes when the number of tubes renewed in any one boiler during a single calendar month is less than five per cent of the total number of tubes in that boiler; but, if the necessary renewals in any calendar month total more than five per cent of the total number of tubes in the boiler, the cost of such renewals shall be paid by the owner. The cost of all other repairs, renewals of parts, and the rolling of old boiler tubes shall be paid by the Lessee.

Alternate Paragraph Re Boiler Tubes: If in order to continue operation it becomes necessary to renew boiler tubes in any equipment, the cost of labor and materials used in making such renewal shall be adjusted between the parties hereto on a basis of fifteen months' life for the new tubes, and the Lessee shall pay one fifteenth of such cost for each month after such renewal that the equipment is in his possession. The cost of all other repairs, renewals of parts and rolling of old boiler tubes shall be paid by the Lessee.

Article IX

Liability of Lessee: The Lessee shall indemnify the Owner against all loss, damage, expense and penalty arising from any action on account of personal injury or damage to property occasioned by the operation, handling or transportation of the Equipment during the rental period.

Article X

Inspection: The Owner shall have the right at any time to enter the premises occupied by the Equipment and shall be given free access thereto for the purpose of inspection, and he shall make an inspection immediately upon return of the Equpment —such inspection to be at the Owner's expense. Any loss or damage to Equipment shall be listed and notice thereof supplied to the Lessee within ten days after receipt of the Equipment or otherwise the Lessee shall be released from any loss or damage claims.

Article XI

Title: Title to the Equipment shall at all times vest in the Owner unless transferred to the Lessee through sale. The Lessee shall give the Owner immediate notice in case any Equipment is levied upon or from any cause becomes liable to seizure.

Article XII

Termination of Agreement: Should the Lessee default more than thirty days in any payment, or become bankrupt, fail to maintain and operate or return the Equipment as hereinbefore provided, the Owner shall have the right after three days' notice to terminate this agreement, to take possession of the Equipment, and to recover from the Lessee all rental due, full damages for any injury to, and all expense incurred in returning the Equipment to the Owner's yard.

Should the Owner fail to ship the Equipment as hereinbefore stipulated, this agreement shall, at the option of the Lessee, become void.

Should the Equipment, upon receipt by the Lessee, prove not to be in good repair, or good working condition, the Lessee shall within five days so notify the Owner and shall then have the right to make necessary repairs and collect the cost thereof from the Owner; or if the necessary repairs cannot be made within reasonable time and expense as determined by the Lessee, the Lessee shall have the right to cancel the agreement, to return the Equipment at the Owner's expense, and to recover any monies paid to the Owner.

Article XIII

Insurance Premiums: The Lessee shall pay all premiums for fire, liability and other insurance which he may carry upon the equipment.

Article XIV (Optional)

Bond: The Lessee shall furnish a bond with sureties satisfactory to the Owner to the amount of the total value of the Equipment as stipulated in the List of Equipment, to insure return of the Equipment in good condition.

Article XV

Sub-Letting. No Equipment shall be sub-let by the Lessee, nor shall he assign or transfer any interests in this Agreement without written consent of the Owner. No modifications of this Agreement shall be binding upon either party unless mutually accepted in writing.

Article XVI-A (Optional)

Optional: Should the continuous total rental paid to the Owner for any units of the Equipment amount to one hundred and fifty per cent of the value of such units as stipulated in the List of Equipment, no further rental shall be paid to the Owner and the title of such units shall vest in the Lessee.

The Lessee shall have the right at any time to purchase any part of the equipment by paying the difference between the total continuous rental already paid and one hundred and fifty per centum of the value given in the List of Equipment, and payment of such difference shall be made upon such terms as the Lessee and the Owner may decide.

Article XVI-B (Optional)

Optional Clause: Should the Lessor agree to sell and should the Lessee agree to buy any article of equipment prior to surrendering possession thereof, the purchase price of any such equipment shall be the value stated in the List of Equipment and . . . . . . per cent of the rental paid on such articles shall apply as payment therefor and the remainder be paid as the Lessee and the Owner may agree.

Witness the hands of the parties hereto the day and the year first above written all in duplicate.

Witness

. . . .

Witness

. . . .

The Contract Record's

Weekly House Suggestion No. 10

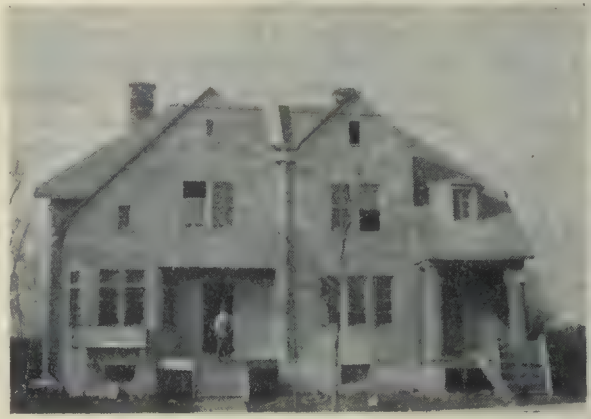
The semi-detached cottage, illustrated in the accompanying plans and photograph, was designed for a lot measuring 60 feet frontage by 120 feet in depth and permits a space 6 ft. 6 ins. clear of side lines for right of light and passage of motor car, etc. The foundation was built by placing a form on the outside only and building an 8 in. thick breeze block wall to form the inside form, leaving an eight inch space between for concrete. The floor joists and rough floor were put up, resting on the breeze block wall, and the mixing and pouring was done from this.

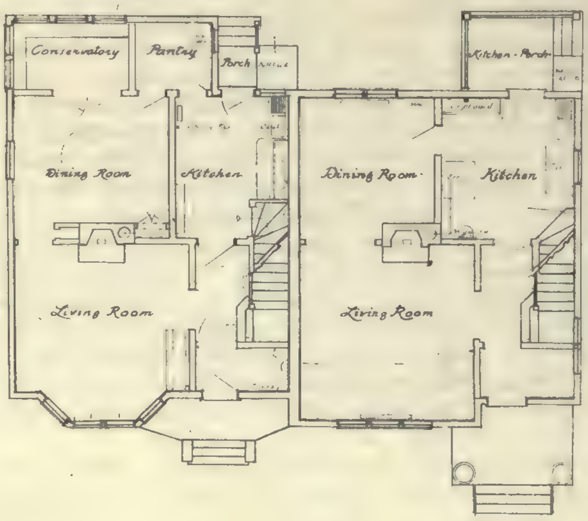
The frame is of 3 in. plank, 3 in. x 11 in. framing for upright at corners and openings with 3 in. x 5 in. T. & G. hard spruce for filling in of panels. This plank is sheathed outside with Duro coated sheathing which has protected the walls most of the winter while waiting for Bishopric and stucco finish. The inside of plank is lined with Cabot's quilting, furred, lathed and plastered.

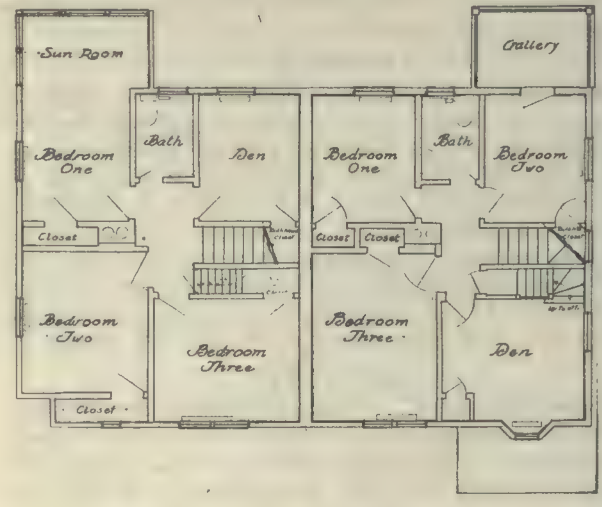
The sloping roofs are of crushed slate coated asphalt shingle of a grey color. Rough cast is of natural color.

The plans shown herewith are self explanatory. It will be observed that the two houses differ somewhat in layout, although the same number of rooms are involved. In one house, a pantry and conservatory are provided on the ground floor and a sun room on the upper floor, while these features are omitted in the other house. In each case the three bedrooms are provided with ample closet space.

The endeavor has been to give an individuality to each house and to economize in planning. The passage area on ground floor is 36 sq. ft. or 5% of the total house area, while upper halls are 40 sq. ft. or 6% of upper floor area. The cost of the pair of houses was about $19,000, exclusive of land. The architect for the pair of houses was Thomas McLaren, 264 Beaver Hall Hill, Montreal. F. Henderson & Son, Lachine, P. Q., carried out the general contracting work. The houses are located on Percival Ave., Montreal West.







No. 35

Canada's Contractors—John Tucker

Mr. John Tucker, secretary-treasurer of the Dominion Construction Co., Ltd., Vancouver, B. C., is an Englishman by birth. He is a member of the Chartered Institute of Secretaries, and got his training in England before coming to Canada. Most of his business experience in England was in Bristol, where he was for same years with the engineering department of of Bristol corporation. When the great Avonmouth dock works, at the mouth of the river Avon, involving an expenditure of approximately two million pounds sterling, were begun, Mr. Tucker was sent by the engineering department of Bristol corporation to take full charge of the office at Avonmouth. For this important undertaking the consulting engineers were Sir John Wolfe Barry and Sir Benjamin Baker and the contracting firm was Sir John Aird & Co. Mr. Alfred Pearce was resident engineer on this work, being afterwards succeeded by Mr. Andrew Don Swan, now consulting engineer to the Vancouver Board of Harbor Commissioners and designer of the Ballantyne Pier now under construction at Vancouver.

Mr. Tucker, while at Avonmouth, had full charge of all accounts and correspondence in connection with this important undertaking. On completion of the main contract Mr. Tucker had the offer of a position in the cost department of the British American Tobacco Company, Bristol. While in that position, he had experience in the cost of repairs and upkeep of machinery, plant and construction of new buildings.

Mr. Tucker came to Canada in 1910, and in May of that year joined the staff of the Dominion Construction Co., Ltd., as accountant, being appointed secretary-treasurer two years later. That position he still holds, and in the experience of his duties has had entire charge of the accounting and costs on every contract executed by the company in its wide and successful experience.

During the past ten years the Dominion Construction Company have carried out many important contracts in Vancouver and district. Among these a few that may be mentioned are: Yorkshire Building, a 10-storey office block, costing $270,000. Shaughnessy Heights residence and grounds for the late B. T. Rogers, Esq., costing $190,000; extension to the Tranquile Sanitarium, near Kamploops, for the Soldiers Civil Re-establishment, costing $250,000; Capitol Theatre Vancouver, 1920, one of the finest theatre buildings in Canada total cost in the neighborhood of $400,000; extension and alterations to the David Spencer Limited departmental store, involving an outlay of over $250,000—an interesting and difficult piece of work, including the underpinning of nine floors and the removal of a brick wall, 80 feet long and 120 feet high, putting in its place steel columns and girders to connect up with the floors of the new addition; another item was a reinforced concrete fire tower, 15 x 24 feet, and 140 feet high, connecting 9 floors, basement and roof garden to the street. In 1921, erection of the town of Ioco, on a new site on Burrard Inlet, opposite Port Moody, 12 miles from Vancouver, was carried out at an approximate total cost of $160,000. Forty dwellings were built and fourteen moved from the old site. Other contracts executed in recent years have been the construction of wharves and bridges, piledriving, fillwork, etc., at Westminster, Victoria and Vancouver. The Keith Road bridge, North Vancouver, the fill at Coal Harbor, Vancouver, and the building of two slipways at the Coughlan shipyards are among the general work of this nature completed by the company.

Mr. John Tucker

Projected Engineering Works for India

In view of the fact that British investors have lately placed more than £20,000,000 in new enterprises in India and Ceylon, special interest attaches to a report which has just been received in London from the Inspector General of Irrigation in India, who indicates the means by which the various provincial and municipal authorities are assisting the central government in making provision for large new public services necessary to the industrial development of the country, says Manchester Guardian Commercial.

At Calcutta large engineering projects are under consideration, while extensive schemes of drainage and sewage are to be undertaken at Bombay. The inspector general states that, since the armistice, undertakings estimated to cost 400,000,000 rupees have been either sanctioned or submitted for approval. Much of this work has had to be undertaken by government officials, for the sole reason that there is very little private enterprise in the country, and the promoters of the various schemes would gladly welcome the advent of firms who would be able and willing to undertake the work. "Never," says the inspector general, "has India needed engineers more than at present," to which may be added that never has India offered better opportunities than now to firms for machinery, engineering supplies, and other equipment.

Mainly Constructional

East and West—From Coast to Coast

The Toronto Transportation Commission is planning a continuance of its extensive construction program during the coming season. This work will consist largely of the elimination of the narrow devil strip on practically every mile of track in the city. It is estimated that this program will involve an expenditure of $12,000,000.

Every effort will be made to complete the Hamilton-Niagara Falls highway this year, according to Mr. F. C. Biggs, Minister of Highways for Ontario. If new construction cannot be completed, the road will at least be put in passable condition during the approaching road building season.

The Royal Victoria Hospital, at Montreal, has approved of the donation of 50,000 ft. of land for the erection of a hospital for crippled children, by the Mystic Shriners of North America. This building will cost $250,000 to erect and will provide 50 beds. The Shriners are erecting five hospitals of a similar type at the present time in the United States.

The building concern of Roanoke Homes, Limited, at Hamilton, has announced that they will erect, during the approaching building season, fifty medium sized homes in that city at an estimated cost of $5,000 each.

Representatives of the Ontario Town Planning and Housing Association waited on Premier Drury recently to ask the Government to take steps to further their cause during the coming session of the Legislature. W. S. B. Armstrong, of Toronto, was spokesman. They asked that the Government make use of the $2,000,000 left over from the Federal Housing Scheme to further town planning. The Premier promised the deputation favorable consideration.

Merkleys Ltd., Fraser Bldg. Ottawa, have just completed arrangements whereby they will manufacture interlocking tile, formerly known as Denison interlocking tile. These arrangements have been made with the head office of The Interlocking Tile Co. Ltd., 32 Toronto St., Toronto.

Officers of the Dominion Land Surveyors' Association for the year 1922 were elected recently at the concluding session of the association's annual convention at Ottawa. Mr. G. H. Herriot, of Winnipeg was elected president. Other officers are: Vive-president, Mr. D. H. Nelles, Winnipeg; secretary-treasurer, Mr. W. L. MacIllquhane, Winnipeg.

It was decided at the annual meeting of the Alberta Architectural Association, held recently in Calgary, to move the heaquarters of the association from Edmonton to Calgary for a period of two years. It was the practice at one time to have the headquarters of the association alternately in Calgary and Edmonton, for two year periods, but since the war, the offices have been located at Edmonton. The meeting elected J. E. Burrell president for 1922 and R. A. Millar, secretary-treasurer.

Applications for housing loans from points in Manitoba, exclusive of the larger cities of Winnipeg, St. Boniface and Transcona, already exceed the total appropriation for the province for this year, it is stated. The amount which it is proposed to borrow is $1,000,000 and applications so far have reached a total of $1,525,000, made up as follows, with several other municipalities, including the three cities mentioned above, to be heard from: St. James, $500,000; St. Vital $250,000; Fort Garry, $300,000; East Kildonan, $225,000; West Kildonan, $250,000.

The Ottawa Housing Commission's report for 1921 shows 136 houses constructed during the past year, 132 of which have been disposed of.

Effective steps towards controlling the speed and loading of motor trucks in the province of Quebec, with a view to preserving the public highways in all parts of the province, will be taken by the government this session.

About 40 members of the Brandon Builders' Exchange, of Brandon, Man., were present at the annual banquet, held recently at the Y. M. C. A. Mr. Frank Lissaman, president of the exchange, presented his annual report, which was very optimistic in regard to the 1922 outlook for building in Brandon district.

It is reported that the Page-Hersey Pipe Mills, at Welland, Ont., are now in full operation again, with day and night shifts, between 250 and 300 men having been added to the staff recently.

A group of Canadian and American Capitalists are planning the opening of a new townsite between Erie and Crescent Beaches, near Bridgeburg. The necessary permission has been given by the neighboring municipalities of Bridgeburg and Fort Erie, and the development will be proceeded with. This townsite will be largely occupied by summer homes, it is stated.

Plans have been prepared for the erection of a moving-picture theatre at Belleville, Ont., to be known as the Capital Theatre. The new theatre will have seating capacity for 1,600 with mezzanine floor and balcony; will be of fireproof construction and the equipment will be the last word in theatre comfort and convenience. It is expected the new theatre will be ready by September 1 next. The group of men behind this project is composed largely of local business men.

Mr. C. E. Hogarth addressed the Montreal Branch of the Engineering Institute of Canada recently on the subject of "Waste in Industrial Plants by the Use of Natural Water," and suggested many methods for overcoming this waste. Several interesting slides illustrating the mining and development of zeolite, a material used for the filtration of water, were shown.

Obituary

Mr. William Bond, one of the oldest builders and contractors of Woodstock, Ont., died recently aged 82.

Mr. Andrew Maxwell, architect and engineer, died at his home in Holland, Man., recently. Deceased was born in Montreal 77 years ago and graduated from McGill University in 1865. He was at one time connected with the Canadian Pacific Railway on survey work, later joining the Hudson's Bay Company's construction department. He practised architecture in Winnipeg for several years, following which he took up residence in Holland, Man.

Personal

Mr. F. C. Wright, formerly sales manager of the Dominion Road Machinery Co. Ltd., of Goderich, Ont., is ill in a sanitarium at Northwich, Conn.

Mr. Camille Laurendeau, B. Sc. A., graduate of Laval University, son of Judge Laurendeau, of Montreal, has joined the sales staff of the MacKinnon Steel Co., Limited, at 404 New Bircks Building, Montreal, Que.

Mr. M. J. Fennell, formerly secretary-treasurer of the Montreal Harbor Commission, has been appointed to the newly-created office of general manager of that body by Dr. W. L. Macdougald, chairman of the Board of Commissioners. The old system of individual control of the various departments has been superseded by the concentration of the full executive authority in the hands of the general manager.

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No Need to Shout. We Must Build

It sometimes happens that the very thing we are looking for and need most is so close to our nose that we fail to see it.

Is that not the case today in the construction industry?

How frequently it has been reiterated in recent months that one of the biggest obstacles in the way of greater construction activity is the lukewarm attitude of "capital"! Canadian bonds—the best security in the world—were selling on a six to six and a quarter per cent. basis. What chance had a mortgage yielding even 7½ per cent.? And to raise the rate beyond this point increased the cost of construction to a prohibitive point.

But what is the situation today? Almost over night the bond yield has dropped from 6¼ per cent. to 5 per cent.—the 5½-1937 Victory bonds, for instance, at 105, allowing for depreciation at the end of the fifteen year term, work out at almost exactly a 5% yield. Other government and municipal securities are rapidly approaching the same basis.

The unprecedented demand for investments of this kind is due for a pause, then, for the double reason that bond rates have lost much of this attraction and that investors have secured such a large percentage of their surplus in gilt-edge bonds that they are ready to average up with something that yeilds a larger return with somewhat less security. That "something" will be mortgages or industrials in one form or another. The Mount Royal Hotel is an example; this is a much more attractive proposition than it was six months ago.

There is no reason to believe that the country is lacking in capital looking for investment. There never was a time, possibly, when Canadians as a whole were exercising more caution in their expenditures. This, taken in conjunction with reduced prices of commodities, means that there is more money looking for opportunity than, possibly, ever before in our history.

Let us not forget, then, that the return to construction activity may be very near. A year ago everybody was shouting in an endeavor to induce activity. But mere noise is powerless against facts. To-day, however, the building industry has something really worth while to offer—greatly reduced prices of material and greatly reduced money rates. Couple with these the further fact that demand for construction of every kind is accumulating. 1921 bred optimists from necessity—their own necessity. 1922 will also breed optimists but this will be due to force of circumstances that are daily growing more favorable.

* * *

According to the Department of Labor at Ottawa, the index price of rents is higher at the moment than at any period since 1914. This in face of considerable reduction in the price of building materials. Of course, we may argue that the landlords are profiteering, but, after all, is it not a clear case of supply and demand? If there were enough houses to go 'round there would be no rent profiteers. Perhaps nothing emphasizes more pointedly the actual condition of house shortage than some interesting figures recently collated by MacLean Building Reports to the effect that there were 110,000 marriages in 1921 but only 16,000 homes built to take care of the new families. What are the other 94,000 couples doing? Living in rooms, perhaps. But what will they do next year and in the years to come when, with children to care for, they are driven from their present cramped quarters to look for homes?

Does it not appear, then, that whether we shout or not about "build now" the constant accumulation of demand will force the building of homes in much greater numbers than they have been erected in the past? Does it not appear that this condition must be right upon us? With such an assured demand, and cheaper money, has not the contractor ample arguments to convince the man who hesitates, that the time to act is "now."

Symposium on Water Power Development

The interesting announcement has just been made that a Symposium on water power development will be held at the University of Toronto, in room 22 of the Mining Building, from February 27 to March 6. This Symposium has been arranged by the Hydraulic Section of the Department of Mechanical Engineering of the University of Toronto, of which R. W. Angus is the professor.

Lectures will be delivered on various subjects by engineer graduates of the University of Toronto, and others, according to the following program. February 27, 4.30 p.m., "Some of the principles controlling the use and design of hydraulic turbines," and at 8.00 p.m., on the same date, "Hydraulic turbines and installation," by Lewis F. Moody; February 28, 4.30 p.m., "Hydraulic equipment as affecting power house design," by Max V. Sauer; March 2, 4.30 p. m., "Design of power canals, headworks and surge tanks," by Thomas H. Hogg; March 3, 4.30 p.m., "Power house machinery," by W. M. White; March 6, 4.30 p.m., "Regulation and testing of hydro-electric machinery," by

No. 81

Canada's Engineers - A. B. Crealock

One of the most interesting articles the Contract Record has printed in recent issues was that describing the five new bridges which constitute the entrance to the city of Hamilton. This description was from the pen of Mr. Archie B. Crealock, bridge engineer of the Public Highways Department of the Province of Ontario. Though a young man, Mr. Crealock has had a wide and varied experience. He was born in Toronto in 1893 and educated in that city, graduating from the University, in the Department of Civil Engineering, in 1915. Prior to graduation he was with the Toronto Harbor Commission, employed on the original survey of the Toronto water front. In 1915 he was attached to the staff of the Civic Transportation Committee in Toronto, and assisted in compiling the report on the street railway system and radial railway entrances to the city, which was prepared in that year. Later he joined the Canadian Inspection and Testing Laboratories, Ltd., and was located as chief inspector at the Brown Copper & Brass Rolling Mills, New Toronto; for a period, too, he was at Detroit in the plant of the Michigan Copper & Brass Mills, and at Lachine, Que., in the Dominion Copper Products' plant. When in 1917 this latter organization was taken over by the Imperial Ministry of Munitions, Mr. Crealock was attached to the Cartridge Case Department. Later he was transferred to head office on a micro-photographic study of copper and brass, and early in 1918 was transferred to the Aeronautical Inspection Department, where he occupied the position of metallurgist at the Willys-Overland plant.

It was in March, 1919, that Mr. Crealock joined the staff of the Department of Public Highways of the Province of Ontario, at which time an extensive road construction program was just being initiated. He at once concentrated on bridge work and a little later was made bridge engineer of all work done on the provincial highways system, which covers something over 1,800 miles of the main roads of the province, on which construction is carried out directly by the Department. As examples of the class of work coming under Mr. Crealock's direction, there may be mentioned the Rouge River Bridge, 652 ft. long, with a 5 per cent. gradient; the Raisin River bridge, 170 ft. clear span; the Hamilton entrance bridges, described in our issue of February 1, and the Thames River bridge at London, Ont., with a 194 ft. span, which is under construction. Tenders are now being called for a 655 ft. bridge over the Highland Creek.

Mr. A. B. Crealock

Mr. Crealock takes a keen interest in alumni matters, as evidenced by the fact that he is president of his graduating class for the current year.

Norman R. Gibson; March 6, 8.00 p.m., "Some economic aspects of hydro-electric power development," also by Mr. Gibson.

Speaking of the purposes of the Symposium, the announcement states that from the standpoint of the student, the purpose is more especially to bring him in direct contact with the engineers responsible for the great hydraulic developments in America. It is intended to supplement the course in water power engineering and hydraulics now given, and to give students a somewhat broader vision.

To the practicing engineer it is believed the lectures will also be of value on account of the eminence of the lecturers, and it is also hoped that it may bring these engineers into a more vital relationship with the University. The hours set for the lectures are specially arranged for the benefit of engineers.

The Twenty-fifth Annual Meeting of the American Society for Testing Materials will be held June 26-July 1, 1922, at Atlantic City, N. J. Headquarters will be at Chalfonte-Haddon Hall Hotel.

"I beieve the largest element of waste causing interrupted production has to do with labor. * * * What can interrupt a building project more than to have one set of men come in and do a little work, another set coming in to do a little more, and so on, each set contributing apparently as little as possible to the completed building?"—T. T. Flagler at the A. G. C. conference.

In construction, according to E. T. Trigg, of the National Federation of Construction Industries, the public are interested in three principal things. They are interested to know whether or not they can finance a projected job, whether they can buy the materials at local prices which fairly reflect the reductions made in wholesale prices and whether or not labor employed on the job is to give a full day's work for a full day's pay.

Contract Bonds for Construction Work

The Third of a Series of Articles Dealing With Contractor's Guarantees—The Advantages of Bid, Performance and Maintenance Bonds

By A. E. KIRKPATRICK
General Manager, United States Fidelity and Guaranty Co., Toronto

There are three parties to the Contract Bond:

(1) The owner
(2) The contractor
(3) The bond company.

The owner is the individual or company who pays for the performance of the work.

The contractor is the individual or company who for certain specified remuneration agrees to erect and complete the work to the satisfaction of the owner.

The bond company is the third party who agrees, at the request of the contractor, to guarantee the owner against loss, by reason of his having entrusted his work to the contractor.

There may be three types of contract bonds on the same piece of work, namely:

(1) The bid bond
(2) The performance bond
(3) The maintenance Bond

Bid bonds we shall treat separately as a modern development rapidly replacing the marked cheque or cash formerly deposited by a contractor with his tender.

The taking of security by the Owner from each contractor who tenders on a job is fraught with certain obligations often overlooked. Cash or negotiable securities or a marked cheque deposited with an owner immediately places on him the onus of responsibility for their care, insurance and safe return to the contractor. Should such securities be lost, stolen or destroyed, they should at once become a charge upon the owner, totally unexpected by him and for which he is entirely unprepared. An unnecessary hardship also devolves on the contractor in that all but the successful contractors have had their credit operations limited to the extent of their deposit during the whole time the tenders are under consideration. To both the owner and the contractor this system has proven its weakness until to-day enlightened owners and contractors refuse to have anything to do with such a system.

The bid bond of a bond company is the bond company's promise that the contractor is acting in perfect good faith and will sign up the contract if let to him. The bond company endorses and guarantees the contractor's figures and many owners refuse to open or consider any tender not endorsed by a bid bond signed by a reliable bond company.

As this bid bond automatically lapses if the contractor is an unsuccessful bidder and as it is replaced by the contract bond in the case of the successful tenderer, the documents themselves are valuable so long as their value is needed and lose their value automatically when they have filled their need. This means a great saving in time and energy which can best be imagined by visualizing six unsuccessful contractors each spending several hours of their time and the time of the owner getting back and cancelling marked cheque, or withdrawing and replacing in their safe deposit box negotiable securities which may be lost or stolen in transmission.

Enough has been said to show the manifest advantages surrounding the use of bid bonds, which accounts for the rapid growth in their popularity during recent years.

The Contract Bonds

The contract bond itself is an unfailing source of strength and protection to the owner. The bond company has, when it signs its bond, linked its fortunes to those of the contractor—his success is its success, his mistakes or misfortunes are theirs; if the owner carries out his contract so must the contractor, and the failure of the contractor is the bond company's loss.

Can we wonder, therefore that the bond company is careful in choosing its friends, or can we wonder at the friendly spirit which exists between the contractor and the Bond Company? Their interests are so alike that mutual respect and confidence is the basis of all their relations.

The maintenance bond carries with it an obligation, that the work performed will not show defects for a given period. Roofs, pavements, engines, pumps, are some of the things the efficiency of which is often guaranteed for some period beyond the date of completion.

The bond company cannot move away and, from the standpoint of its obligations, it can hardly fail, because in Canada a wise government requires large security deposits to cover its issued bonds.

To sum up-the Contract Bond is one of the most important adjuncts to modern finance and credit.

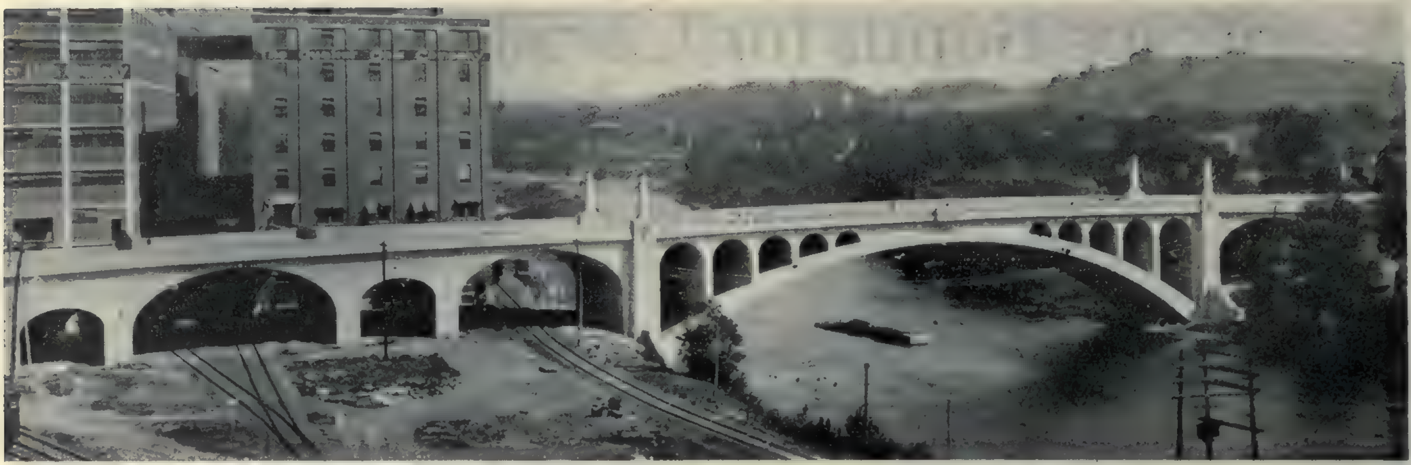
Under old conditions, in good times, millions of dollars of credit was tied up in cash deposits, while today the millions of dollars of assets of the various bond companies are loaned to the contractors of the country and such credits are joined to the mass of credit which the community at large enjoys.

Credit more than money is the basis of financial prosperity and financial progress. A country which wisely makes full use of sources of credit is in exactly the same position as an individual directing a successful business, where credit is the foundation stone of success.

The Federal government at Ottawa is backward in this respect but where provinces, cities and individuals have led the way an enlightened government is sure to follow, to the good of the country at large and the contracting fraternity in particular.

The Annual Convention of the American Association of Port Authorities will be held in Toronto, September 14, 15 and 16, 1922.

The city council of Chatham, Ont., accepted the recommendation of the city engineer's department regarding a site for an incinerator. Plans and specifications are expected to be ready shortly, when bids will be called for. Mr. C. H. R. Fuller is city engineer.



The largest single concrete arch in Canada over the Otonabee river in Peterborough, Ont.

Canada's Greatest Concrete Bridge in Peterborough, Ontario

Recently Completed Structure Comprises Ten Approach Spans and a Main River Span 234 ft. in Length—Aesthetic Features Given Special Consideration—River Span Designed with True Spandrel Arches Without Beam and Slab Floor System

By FRANK BARBER
Consulting Engineer, of Frank Barber & Associates, Ltd., Toronto

The High Level Bridge over the Otonabee River, Peterboro, recently completed, represents one of the most important pieces of construction work carried out in Canada in recent years. Work was commenced in August, 1919, and completed just two years later in August, 1921. The structure, generally known as the Hunter St. bridge, replaces a steel bridge of two spans, of much lower elevation.

The new bridge is of concrete and is made up of ten approach arches, five on each side of the river, with one main river span which is 234 ft. in length—the largest single concrete arch span in Canada. It was built as the result of an agreement between the Quaker Oats Company, who own the land on either side of the river at this point, and the city of Peterborough, following the disastrous fire at the above company's plant in 1917. The bridge contains 15,000 cu. yds. of concrete and 180 tons of steel. There are 1172 lineal ft. of concrete in the eleven arches and approach walls, four of the arches being 30 ft. in length, six 60 ft. and the main river arch 234 ft. with a total of 7,000 cu. yds. of earth fill on both sides of the river. The floor of the bridge is 52 ft. above low water level. The roadway is 35 ft. wide between curbs and carries a single track electric railway line.

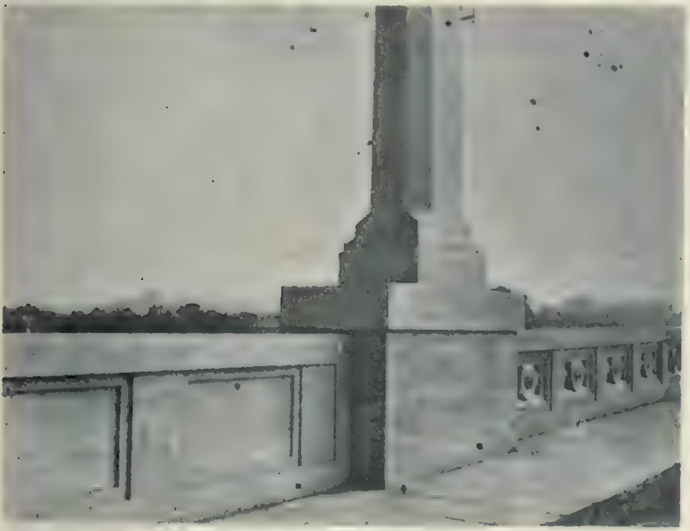
Approach Spans

The sidewalks on the approach spans project out over the spandrel walls 2½ ft., by cantilever construction on the top of these walls, but aside from this feature the arches are of the ordinary earth filled type. The piers under the approach spans are solid from side to side of the bridge, at the height of the skew-backs, but below this each pier is pierced by a transverse arch, dividing the pier into two parts, with 12 ft. spaces. In order to provide uniform bearing upon the foundations, of four tons to the sq. ft.—the maximum allowed by the chief engineer of the Ontario Railway Board—spread footings were used for the piers. The structure, at the west abutment, rests upon bed rock, the eastern abutment being on a very hard hard-pan.

The necessary clearance for an overhead crossing of the steam railway sidings at the west approach was the factor that determined the elevation of the bridge floor, it being impossible to alter the elevations of the railway tracks as they must conform to the loading floors of the Quaker Oats Company's plant immediately on the north side of the bridge. This condition resulted in the elevation of the bridge floor being 6 ft. higher than the general elevation of the city streets, which necessitated a grade up to the bridge on either side.

One of the first problems to be solved in the designing of the bridge was, therefore, to devise a type of structure that would leave the floor at as low a level as possible, for traffic accommodation, while fulfilling the requirements of the Dominion Railway Board as to clearances above the railway siding. The problem of bridging railway sidings in pairs would be comparatively easy, generally speaking, as railway sidings are ordinarily 13 or 14 ft. apart, centre to centre, but the sidings in question were something over 20 ft. apart on centres and would cross the bridge approach on curves and cut a sharp angle. The location of the sidings was altered as far as possible to suit the necessities of the bridge, the sidings being made more nearly to approach a right angle crossing, which layout was approved by the Railway Board. After extensive investigation to secure a type of construction with the least difference in elevation between the floor of the bridge and the under side of it for the space required by the Railway Board, according to their diagram of clearances, flat arch construction was decided to be a better solution of this particular problem, than steel girders or concrete beams.

The soffits of these flat approach arches are semi-ellipses, the curvature being found in the following manner: the dead load line of resultant pressure was made to fit exactly the neutral axis of the arch and the required depths of the arches from crown to skewback was found to be such that the soffit of the arch, except quite near the skewback, was practically an arc of an ellipse. A true semi-ellipse resulted for the curve of the soffit from thickening the arches quite close to the skewback. Except in the case of flat arches, the designer of this bridge has found that a semi-ellipse for the soffit is not possible for the most economical design of curvature.


Aesthetic features were given special consideration. Note inset panels in the handrail

Needless to say, the dead load horizontal thrusts of all the approach arches are exactly the same, so that there is no turning moment on the piers from dead loads. The horizontal thrust of the 30 ft. arch, by making the smaller arches sufficiently flat, is made equal to that of the 60 ft. arches. The elevations of the 30 ft. arches were kept sufficiently low to allow the dead load line of resultant pressure on the smaller arch to meet that from the larger arch on the vertical centre line of the pier.

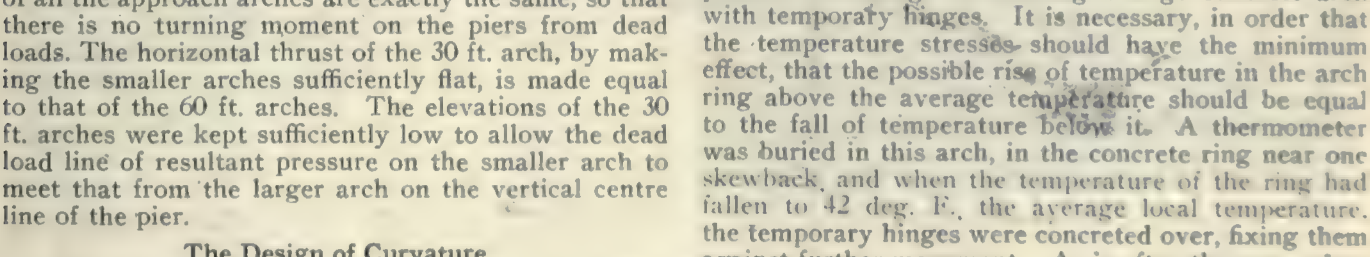
The Design of Curvature

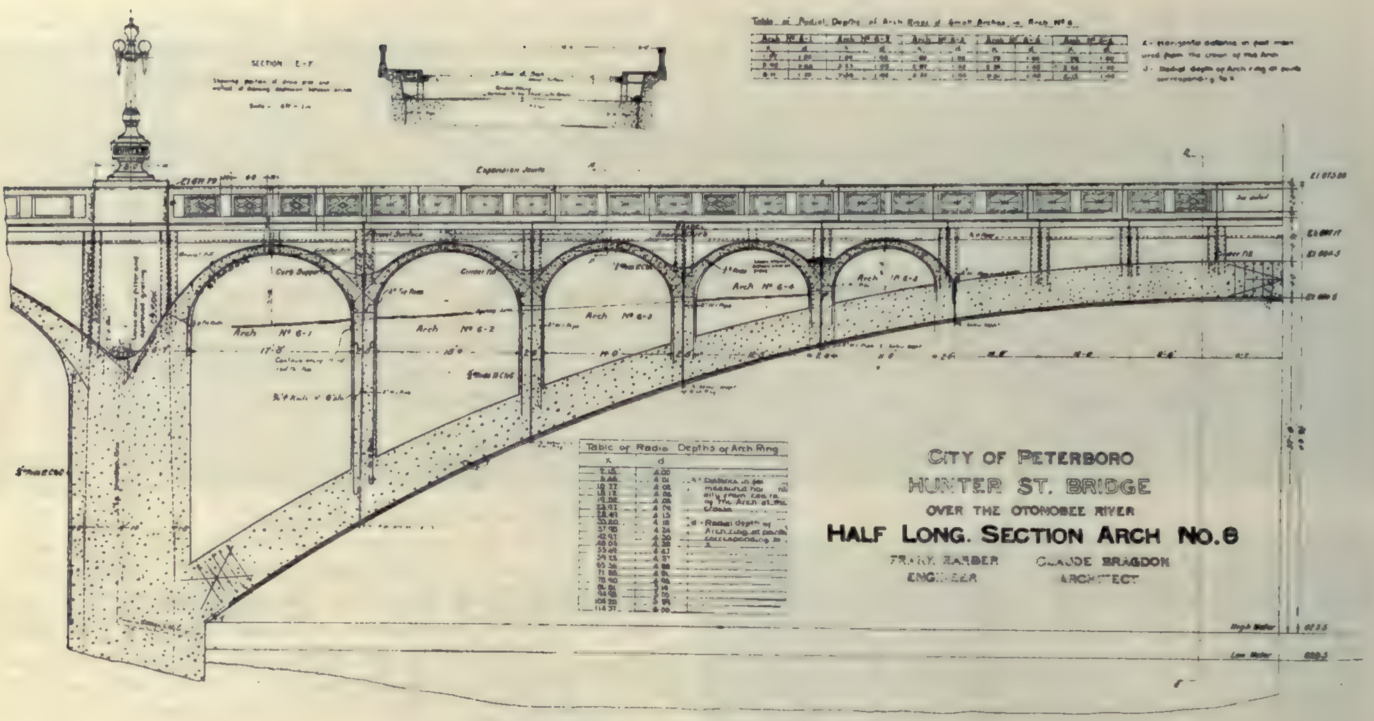
Although the curvature of the neutral axis may be made to fit the line of resultant pressure by a "Trial and Error" graphic method, the direct design of curvature is possible by a much simpler analytical method, using a book of tables of hyperbolic functions, which method has been used by the author in the design of all his arches for some years. There can be no bending moments in such a design, in any part of the arch ring, from dead loads, and, consequently, dead load stresses are uniform compression on any section. Tensile stresses, however, result from live loads and temperature. As sometimes happens, the maximum tensile stresses are not as great as the dead load compression stresses in which case there will never be tension on any part of the arch, and, therefore, reinforcing steel is not necessary. In very large arches where the dead loads are great compared with live loads, this is generally the case. In this structure, the river arch ring is plain concrete without any reinforcing. It may be interesting to note that most of the designers of the great arches of the world have found similar conditions. In 1911, the designer of this bridge made a list of all the concrete arches over 175 ft. in span, thirteen in all, of which only four were reinforced.

The river arch, as is the custom in all great arches, was poured in voussoirs of about 14 ft., leaving key spaces of about 4 ft. between them, which were concreted after the voussoirs had set. Two purposes were accomplished by this method; it prevented internal stresses due (1) to the settling of the arch ring upon the centering, and, (2) from shrinkage of the concrete in setting, which developments had practically taken place before the key spaces were concreted. The arch ring contains over 2,000 cubic yards, without the superstructure, and, consequently weighs upwards of 4,000 tons.

Advantages of Temporary Hinges for Arch Ring

To ensure the neutral axis following the line of pressure, as required by theory, the arch ring was built with temporary hinges near the skewbacks and at the crown, which expedient of temporary hinges has been used by many designers of large arches. After the superstructure was completed and the full dead weights applied, the hinges were concreted over and fixed against further movement, at which time the line of pressure must pass through the middle of the section at the three hinges and consequently follow it very closely at all other points. There is a further possible advantage of building a large concrete arch with temporary hinges. It is necessary, in order that the temperature stresses should have the minimum effect, that the possible rise of temperature in the arch ring above the average temperature should be equal to the fall of temperature below it. A thermometer was buried in this arch, in the concrete ring near one skewback, and when the temperature of the ring had fallen to 42 deg. F., the average local temperature, the temporary hinges were concreted over, fixing them against further movement. As is often the case, when na arch is closed in a warm season, it might be noted that the natural heat of the season and the unnatural heat generated from the setting of the cement, cause

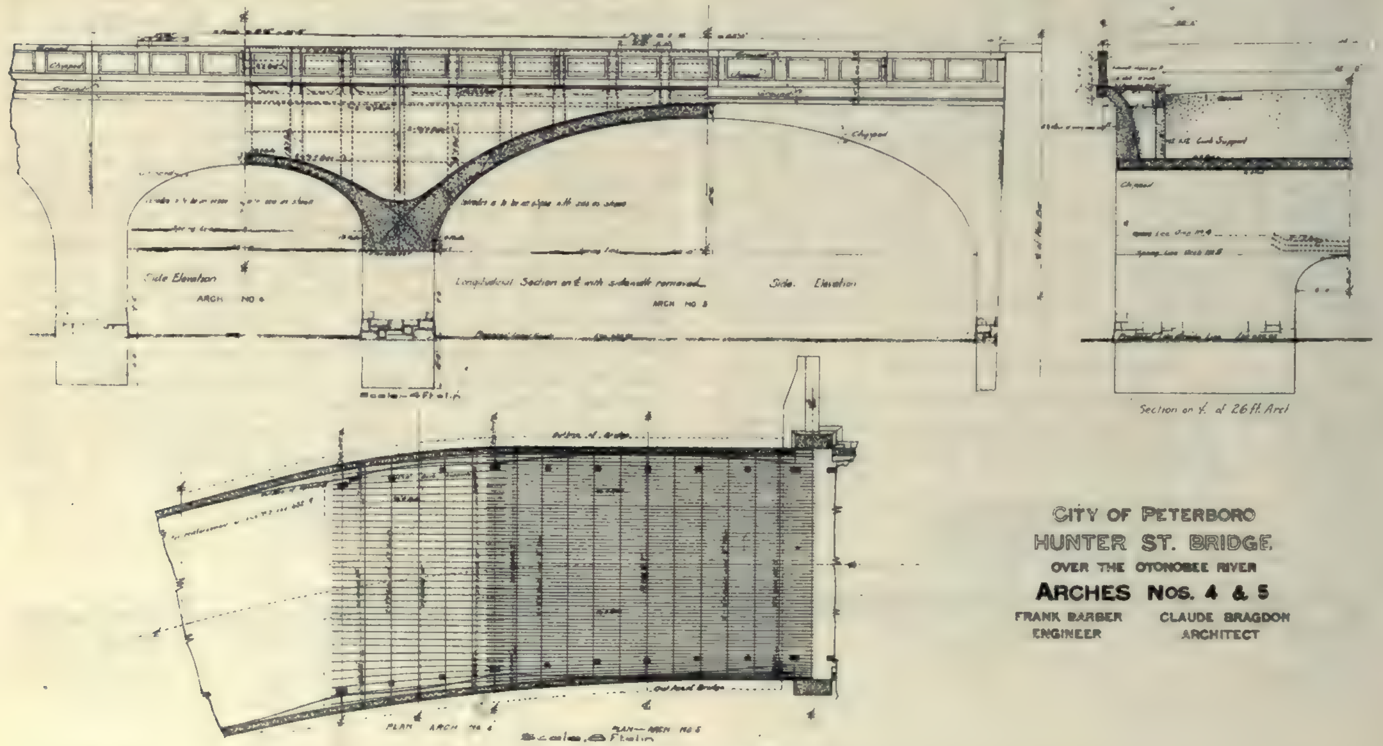

The bridge including the main span and ten approach spans, is 1178 ft. long



Half longitudinal section of the main arch

the arch ring to attain a greater temperature than is to be expected at a later time. Thus, the maximum temperature stresses, which would in this case occur in the coldest weather, would be more than double what they would have been had the ring been closed when its temperature was midway between the high and low temperature of the year. This principle of minimizing the temperature stresses has been taken advantage of for the first time, it is believed, in this structure.

Unlike most open spandrel arches built up to the present time, which have been of beam and slab con struction in the floor system, this river arch is designed with true spandrel arches, being barrel arches, with a cinder fill above them. Comparing the merits of the two systems, it will be found that beam and slab construction results in slightly less concrete and less dead weight imposed on the large ring, but, on the other hand, this type of construction requires much more steel than arches and involves greater labor and false work. Although previous to the beginning of the war the saving of concrete materials was worth more than the saving of labor and steel in arch construction, conditions, at the time this particular arch was designed, had changed, concrete materials having not advanced in price to the same extent as la-



Details of arches Nos. 4 and 5

Centering for the main arch of the Peterboro bridge

bor and steel. Two further examples of similar construction were the recently completed bridges at Lyons, France, and Pont Sidi Rached, Algeria.

Where the floor system is of beam and slab construction, the overhang of the sidewalk is generally greater, as the cantilevers upon which the sidewalk rests are simply the ends of the floor beams. In spandrel arch construction, however, there are no floor beams, of course, and sidewalks cannot be made to overhang to the same extent.

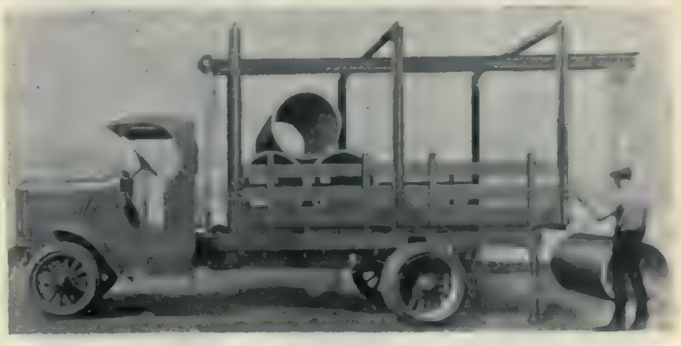
In spandrel arch construction, an advantage worth noting is that the spandrel arches may be made successively smaller from the skewback to the crown, this fore-shortening of the spandrel arches towards the crown resulting in saving of material, the arches becoming smaller as the spandrel piers become shorter, while it must also be admitted that the appearance of the spandrel arches is greatly improved over the more ordinary case where the spandrel spans are uniform. Economy, however, requires that the size and reinforcing of the joists in beam and slab construction be uniform. The uneven spans were chosen in this case primarily on account of their appearance, the feature of economy becoming apparent later. Mr. Claude Bragdon, consulting architect on the bridge, is responsible for this feature in the design, which is believed to be original.

It was originally estimated by the civic authorities in 1917 that this structure would cost $225,000, but when tenders were called in the fall of 1918, bids received ran from $334,000 to $381,000, which necessitated the submission of a by-law authorizing the extra expenditure. No difficulty was experienced in having this by-law ratified, however, and tenders were called again in the spring of 1919, three bids being submitted on the lump sum basis, ranging from $260,000 to $263,000, and eight contractors, who figured on the cost-plus basis, estimated the cost from $240,000 to $285,000. Messrs. Russell-Townsend Co. Ltd. were finally awarded the contract at cost plus a fee of $29,500, this amount to cover plant rental, etc. The total cost, however, was slightly over $500,000, materials advancing rapidly in price at this time. A fairly close parallel case to this was that of the Fairmont bridge, in West Virginia. This bridge was begun a little before the Peterborough bridge, and completed somewhat later than it. The quantities were somewhat greater, and the contract was let in the same way, cost plus $40,000. The estimated cost was $338,000, and the final cost somewhat over $800,000.

The bridge was designed by the writer, and Claude Bragdon was the architect, the construction being supervised by the writer. There was a staff of three resident engineers on the bridge, Mr. Fred Christie being chief. Mr. R. H. Parsons is city engineer of Peterborough.

Money Saving Contracting and Municipal Auto Equipment

The illustration herewith shows the Otterson Auto-Loader, an attachment to be applied to a motor truck for loading and unloading heavy articles. It is manufactured and distributed through the Canadian Municipal Equipment Corporation, Ltd., Bank of Hamilton Building, Toronto. The cut indicates how the device operates and shows the advantage it has in hauling operations where heavy commodities are involved. The driving mechanism is quite simple, the truck motor being used to operate the hoist. Two special features distinguish this loader: (1) A worm-geared chain hoist, operated by square, splined or keyed shaft, running the full length of the body; (2) a combination of two reversing friction clutches, giving four distinct movements—up and down, forward and backward—and so designed that no holding device is required. Clutches can be thrown in or out without danger of the article falling.



The same firm also makes the Otterson Auto-Eductor, which is a truck fitted with a special body and flushing apparatus, designed for cleaning catch basins, flushing and sprinkling streets. The equipment consists of proper piping and fittings, arranged to supply water from a 1,200 gal. tank to sprinkler and flusher nozzles at front and both sides of the truck. The eductor device consists of a small casting in which is created a suction by the pump pressure which draws the contents of the catch basin, cesspool or sump through an opening in the side, the refuse being then elevated and discharged into the body. Unlike ordinary flushing equipment, this machine can be used during the winter months as a catch basin cleaner, thereby cutting down the cost of operation.

Another machine handled by the same firm is the Otterson Auto-Ash-Conveyor. This comprises a water-tight body with a bucket or skip which operates on a track attached either to the side or over the rear end of the body, the whole mounted on a truck chassis. The refuse is dumped into the bucket and hoisted into the truck body, which, being tilting and end-dump, can easily release its load at a public dump or incinerator.

Attractive Bank Chambers in Ottawa

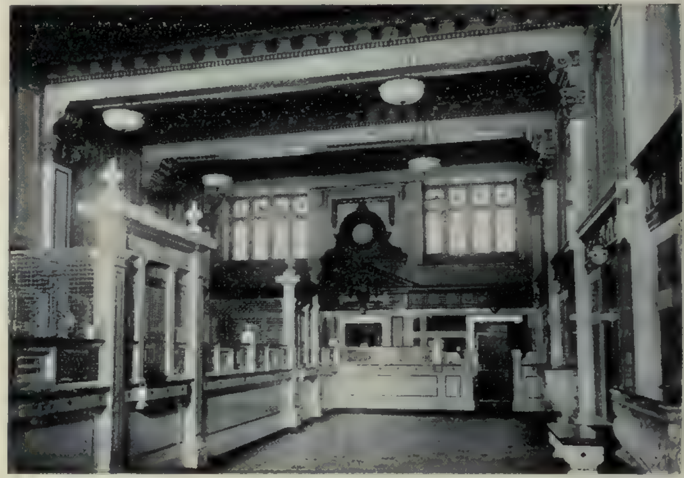
The Banque Nationale Has Erected an Artistic Office Building—Details of Architecture and Construction

By A. LANGLOIS
Consulting Engineer, Ottawa, Ont.

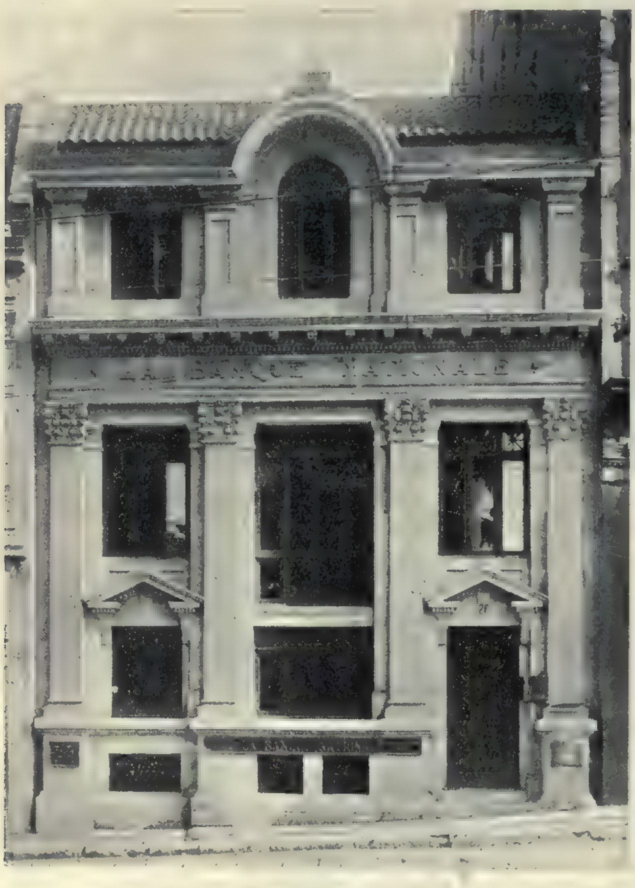
The Banque Nationale has erected at Ottawa, Ont., a small, but very artistically designed office building. Started a year ago, the work on the erection of this building was lately completed.

The building is entirely fireproof. It is built on concrete foundations; with brick side walls, the facade being finished with Indiana sandstone. All floors and the roof are constructed of reinforced concrete, with the partitions of terra cotta. All windows are metal (kalameined) and the stairways made of concrete with marble covering. The inclined part of the roof is finished with copper and spanish tile. The building is equipped with a number of metallic fire doors.

The building is two-and-half storeys in height with an inside space of 30 x 80 ft. The ground floor, entirely occupied by the bank, is 20 ft. in height and is most artistically finished. The walls are covered with marble to a height of 8 ft.; the remaining wall surface, together with the sunken panel ceilings, are finished with plaster and chestnut, decorated cream and ivory. The floor of the public space is tiled; the balance is finished with cherry wood. All counters are solid marble, with solid brass screens. The writing stands and benches are made of marble.



Interior of banking chamber



Exterior of Banque Nationale, Ottawa

The upper storey contains offices, finished in tinted plaster, with all wood work of chestnut. All marble used in the building is Italian white and Belgian red. The cost of the building, exclusive of the lot, was $90,000.

Mr. P. Levesque, of Quebec city, was the architect. The general contractors were Grant Bros., of Ottawa, with Jobin & Genois, of Quebec, sub-contractors for the marble and tile work.

The Ontario Highway Department has announced its intention to pave a considerable portion of the Ottawa-Prescott highway this coming summer.

Members of the staff of the city engineer's department of Hamilton, Ont., held their annual banquet and entertainment on February 22. About fifty of the city employees, together with their friends, took part in the evening's fun-making, which proved to be highly successful. A short address by E. R. Gray, city engineer, was given, and Thomas Towers and W. A. Childs also spoke. Moving pictures were shown.

Ontario Contractors and Supply Men Meet in Peterborough

The Tenth Annual Convention of the Provincial Builders' and Supply Association Opposes Proposed Builders; Lien Act, Urges Employer Representation on the Compensation Board and Protests Against the 8-Hour Day Bill

Peterborough, Ont., was chosen some time ago as the convention centre for the 10th annual meeting of the Provincial Builders' & Supply Association of Ontario, on account of the fact that no builders' exchange had been organized in that city. It was felt that by meeting in a centre where the contractors were not organized, interest in the formation of a local exchange would be stimulated and the local builders would affiliate with the provincial organization and be an active factor in its activities. This object was fully realized, for just a few weeks ago, the builders of Peterborough got together on an organized basis, forming the Peterborough Builders' Exchange in affiliation with the Provincial Builders' & Supply Association. This organization was formed in time to act as hosts to the larger association and give the required local support and enthusiasm to the provincial body during its meeting. The convention of the provincial organization was held on February 21, 22 and 23, and many problems closely affecting the interests of contractors were discussed and the results embodied in suitable resolutions.

Official welcome was given the delegates by Mayor W. H. Taylor of Peterborough, who stressed the importance of the contracting business and urged the necessity of co-operation amongst not only all elements of the business, but also among all sections of the community. Mr. J. J. Duffus, president of the Chamber of Commerce, also welcomed the delegates to Peterborough, pointing out the many features of local interest that would appeal to members of the contracting industry. Greetings from the newly formed local exchange were also conveyed by Mr. Duncan, the president.

In his presidential address, Mr. Norris Gibb, urged co-operation and unity amongst the builders and supply men. He outlined matters to be discussed, mentioning particularly the proposed amendments to the Mechanics' Lien Act, representation of the contracting industry on the Workmen's Compensation Board, apprenticeship, wages based on competence and productiveness, and public opening of tenders. He also offered the suggestion that the convention should register their approval of the use of bonds instead of cheques and should also recognize the value of more adequate cost keeping systems for the building business.

Following the adoption of the minutes of the last annual meeting and the minutes of two executive meetings, reports were read by representatives of each of the exchanges included in the provincial organization. Peterborough showed very satisfactory conditions and in Kitchener prospects were good, following a fairly busy season. In London it was felt that prices must come down before any great stimulation of building would take place. The representative from Hamilton reported a considerable boom in the last half of 1921, following the reduction of wages. He also pointed out that the Hamilton Exchange was well thought of by municipal and business organizations of that city and its opinion always asked for and taken into consideration. Galt reported a reduction in wages in the middle of last year, while Sault Ste. Marie reported a fair year's work with a little wage trouble at the beginning of the year. Fair prospects was the report of Port Hope, while a good outlook was indicated for Sarnia. The Toronto Exchange also outlined its activities during the past year, mentioning the labor troubles it had experienced.

The meeting decided to draft a letter to the Canadian Manufacturers' Association, offering support in their opposition to the presence of a labor man on the Workmen's Compensation Board. It was contended that employers should be represented on that board, as they, and not the labor side, are paying the dues.

Mr. George Gander, secretary of the association and member of the Advisory Committee on Unemployment, commended the activities of this organization and urged government assistance for the erection of schools and charitable buildings as a means of giving employment to labor.

Resolutions

On February 22, the session opened with a paper by Mr. Gould, of London, on "Wage and Labor Agreements," which paper will be printed in the next issue. issue.

The following resolutions were then presented, discussed and adopted:

(1) That protest be made regarding the appointment of a labor man to the Workmen's Compensation Board, when labor is not called upon to make any contribution to the fund and urging the enlargement of the board to include a representative of the employers and that protest be also made against any increase in the amount of benefits.

(2) That, owing to the increasing number of accidents, the Workmen's Compensation Board be asked to take a re-vote on the matter of the formation of an accident preventive association and that the purpose of this association be clearly outlined by the board when submitting the ballot to the contractors.

(3) That the rate of wages referred to in the fair wage clauses of municipal and government contracts should be governed by local conditions.

(4) That a protest be made against the proposed eight-hour day legislation as this would be very detrimental to the construction industry.

The nominating committee then brought in its report, which was unanimously adopted, the officers being as follows: President, Norris E. Gibb of Sarnia; vice-presidents, P. McLarty of the Soo; L. A. Boss of London; secretary-treasurer, George Gander of Toronto. Executive, Toronto, W. E. Dillon and C. F

Officers of the Provincial Builders' and Supply Association

Norris E. Gibb, President

L. A. Boss, Vice-president

Geo. Gander, Secretary

Till; Hamilton, J. M. Pigott and F. C. Hill; London, T. R. Wright; Galt, J. S. Webster and B. R. Miller; Ottawa, George Crane and S. F. Smith; Peterboro', James Bogue and G. H. Duncan; Stratford, F. Ingram; Chatham, W. H. Hildreth and T. Rayment; Kitchener, Casper Braun; Sarnia, G. A. Anders; Sault Ste. Marie, A. Charters; Blenheim, J. J. Cookson.

The location of the next annual meeting was left to the executive.

Apprenticeship Discussed

At the afternoon session, Mr. Clapperton, of Toronto, read an excellent paper on "Apprenticeship", which will be reprinted in a future issue. Considerable discussion on the topic took place.

A discussion on the Mechanics' Lien Act was introduced by Mr. J. M. Pigott, of Hamilton, whose paper on this subject is published elsewhere in this issue. After considerable discussion, participated in by nearly all of the delegates, it was decided to adopt the stand taken by Mr. Pigott and oppose any change in the present Mechanics' Lien Act, other than those changes suggested by the York County Law Assoc-

Three Members of the 1922 Executive

W. E. Dillon

C. F. Till

T. R. Wright

iation, which rendered the act clearer and more easily understood.

The final session of the convention, on Feb. 23, was devoted to a general discussion of any questions brought up.

It was decided to leave in the hands of the executive consideration of the basic principles of labor relations, as adopted by the Association of Canadian Building & Construction Industries, at their recent Hamilton convention.

On motion of Mr. J. M. Pigott, it was decided to instruct the secretary to get in touch with the building representatives in the legislature and also to communicate with the convenor of the Legislature's Lien Law committee and offer services on matters that affect the builders.

The matter of unemployment relief was left to the executive.

A communication from the Retail Lumbermen's Association, regarding the proposed Builders' Lien Act, was received too late for detailed consideration, but it was decided to instruct the secretary to acknowledge it and to advise the association of the stand which the Provincial Builders' & Supply Association had determined to take on the matter.

It was decided to send to each exchange a list of contractors in the part of the province affected, who were paying dues to the Workmen's Compensation Board, with the object of bringing to the knowledge of the board those contractors who were not listed. In this connection, it was pointed out by Mr. Pigott that it would not always be advisable to bring lax contractors to the attention of the board, as they frequently have so many accidents that the assessment would be greatly increased.

The social side of the convention was not forgotten and on the evening of February 22, a banquet was held at the Empress Hotel, at which the Peterborough Exchange was the host. A paper on "Cost Keeping" and numerous speeches from prominent gentlemen followed the dinner.

New Lien Legislation for Ontario

A Review of the Present Mechanics' Lien Act and the Proposed Builders' Lien Law—The Latter Does Not Offer the Same All-Round Protection as the Existing Legislation

By J. M. PIGOTT
of Pigott-Healey Construction Co., Hamilton, Ont.

For the past forty or fifty years the province of Ontario has had legislation in force for the protection of wage earners on building construction. Because of the lack of opportunity on the part of the wage earner to ascertain the responsibility of his employer and because the nature of the industry to the wage earner means constant changing of his employers, this legislation was very necessary and just.

At one period in the history of this legislation, particularly about six years ago, material dealers or supply men sought and obtained a certain amount of protection in the same way. The supply man is the only business man who sells either his own manufactured product or the manufactured products of others on credit who obtains any such protection. It is only due to the fact that the building industry was dealt with in the special manner referred to in the interest of the mechanic or wage earner and an opportunity presented itself to the supply men to obtain inclusion, that they enjoy this privilege at the present time.

The present Mechanics' Lien Act, which has been in existence for some five or six years, is the result of experience and is the outcome of many amendments from time to time over the period of nearly fifty years referred to. Briefly this act recognizes four parties in the building industry—the owner, the contractor, the wage earner and the supply man. It provides that for the protection of the wage earner and the supply man, the owner must retain from the payments to the contractor under his contract a sum equal to 15 per cent. in cases of contracts over $15,000, and 20 per cent. in cases of less than that amount. It calls upon the owner to protect lien holders or persons who may be entitled to liens under the act out of the percentages referred to, and in addition allows him to pay out of the contract amount exclusive of the percentage any debt justly due by the contractor, and provides that such payments shall be applied on the contract price. The owner, who complies with these simple provisions is not liable for a greater outlay than the sum payable by the owner to the contractor.

While the present act may not be perfect in all its provisions, the general principles have been found to be as nearly equitable for all parties concerned as would appear to be possible. In addition to this, the procedure under the act for all parties concerned is simple enough to be understood and applied. In brief, it means that the owner has to retain certain percentages which are simple to calculate and he must heed

Mr. J. M. Pigott

evidence of debts justly due; the wage earner and mechanic is protected absolutely because the percentages retained will invariably be more than enough to cover the wages which form a first claim. As to the supply man, a reserve of 15 or 20 per cent. is set aside for his security, subject only to wages due, and it is further provided that, exclusive of this, under Section 13, Sub-section 1, he may obtain protection for payment from the owner direct for a just debt exclusive of the percentages referred to. As to the contractor, it protects him inasmuch as the value of the building which he places on a property is given priority over mortgages and other claims and permits him to file his lien and secure himself.

The Proposed New Act

There is now before the Ontario House an act introduced by Mr. Sinclair which was introduced on the 18th of February, 1921, and which has since been amended in certain particulars. It is here proposed to briefly explain this amended act and our objections as contractors, one of the parties vitally interested, to the passing of this bill.

This legislation is admittedly promoted by the Retail Lumber Dealers' Association, and while we believe that contractors or any supply people obtaining all the security possible in the conduct of their business for the protection of their credits, it must not be done at the expense of the owner and the contractor, and we believe that if the Retail Lumber Dealers' Association or the supply house interests concerned will view the provisions of this proposed act from the standpoint of the contractor or the owner, which we do not believe they have seriously done, they will readily see themselves how selfish and inconsiderate such legislation would be.

Outstanding Features of the Building Lien Act

Section 8, sub-section 1, provides that, whenever a payment shall become due from the owner or whenever the contractor desires to draw money, he must make out under oath Form 1, giving names of each mechanic or laborer not paid in full, every sub-contractor, supply man, etc., not paid in full, giving the **amounts due or to become due**.

Sub-section 2: The owner shall retain from any moneys **then due or to become due** an amount sufficient to pay all demands that **are due or to become due** to such sub-contractors, mechanics, material men, etc., as shown by the contractor's statement.

Sub-section 4: Requires the contractor not only to furnish this sworn statement, in the absence of which he has no right or lien and no right to get paid, but it also calls upon him to obtain a similar sworn statement from the sub-contractor, as it is intended that the contractor's sworn statement must also include similar statements from sub-contractors as to the condition of their contracts, and it provides that payments made by the owner before such statements are made or without retaining sufficient money (as the amount due to become due) to pay the mechanics, sub-contractor or material men shall be illegal and in violation of the rights of persons intended to be benefited by this act.

Sub-section 7: Provides that the owner or his agent may demand in writing of the contractor any or all statements herein provided for, and if a contractor or sub-contractor fails to furnish such statements within ten days, he shall be penalized $100 each day he so refuses, and also damages.

Section 9, sub-section 5: The owner, except as herein provided, who makes payments shall not be liable to sub-contractors, material men and laborers for any greater amount than he contracted to pay the contractor, but shall not be entitled to set off any damages which he may sustain by reason of failure in the performance of the contract. The risk of all payments to the original contractor, if made before the contractor has furnished his sworn statement, or if the notice above referred to has been served upon the owner, for a period of sixty days within which time claims for liens may be filed, and no payments made to any contractor before the expiration of sixty days shall defeat any liens, unless such a payment has been distributed amongst sub-contractors, material men and laborers, either in whole or part, but where the original contractor has furnished the statement the owner may pay to the contractor out of the sum lawfully due any amounts lawfully in excess of the claims and demand which are due as evidenced by the sworn statement or notices.

Section 25: Where it is established to the satisfaction of the court that the owner knew or ought to have known that the contract price was inadequate that in the case of sale as provided in Secion 24, the lien holders shall have a prior claim on the unpaid moneys to the extent of the actual value of the work or materials involved.

Responsibility for Sworn Statements

(1) It must be evident to every contractor that the preparation of the sworn statement he is called upon to furnish and his responsibility in obtaining, subject to penalties, similar statements from his sub-contractors, is in itself a series matter if made with the accuracy that this act requires.

(2) It must be apparent, inasmuch as under section 8, sub-section 2, the owner is required not only to retain moneys which are due, but which may become due, that because of his responsibility and risk in the making of such payments and his ignorance of building values and the contract procedure the only safe course for him to pursue would be to retain all moneys until the work was completed if he wished to obtain the protection of the contract sum. Under the present act he only needs to know how to calculate 15 per cent.

Apart altogether from the other minor provisions of the act, these two features are serious enough to concentrate upon the deal with at this time.

Three Types of Owners

From a contractor's point of view we may take three types of owners—the very conscientious owner, who is going to be sure that he does his duty by all concerned; the not over-scrupulous owner, to whom such legislation would offer wonderful opportunities, and the practical owner, familiar with building construction and building contract procedure. In the first instance it will be readily seen that the conscientiousness of the first owner could easily result in the obtaining of estimate payments being made even as great a task as the construction of the building itself, involving long delays and considerable expense. In the case of the second owner it will be seen that this legislation indirectly could place an owner in a position where a contractor might be called upon to finance him either to completion of a building or to a semi-completed point where a loan would be available. In the case of the third owner the act would be disregarded altogether.

This is not a matter of opinion, but would undoubtedly be borne out of developments. We will take, for instance the case of an owner who, having some half-dozen tenders to select from, chooses the bid of a man who is, say, 20 per cent. his competitors, and who may not be too strong financially. Now in the case of this contractor getting the work either he is too low and will lose money or, as we so often see, his price is for some particular reason enough to allow him to make a reasonable profit. The point is that in either case the attitude of the owner will be the same; on him rests the responsibility of protecting those interests which come along towards the end of the work as well as those whose trade brings them in in the early stages. If he is to protect himself, what other course is open to him but to retain (if the opportunity presents itself) a sufficient reserve of money diverted from that due the general contractor himself to at least bring him in line with the other tenders he had received, and where this might be done with good reason it will probably be done for no reason at all three or four times.

Ohio Is No Precedent

The Ontario government in considering this new act appointed a committee who have been hearing during the past six months objections to its enactments. This act is apparently copied or drafted from the Ohio Mechanic's Lien Act. Mr. Urquhart in a memorandum presented on behalf of opponents to the proposed bill has the following to say: "It would appear that in Ohio prior to 1913 they did not have a Mechanic's Lien Act, or if they had, it was not workable and it would appear from the statement made by Mr. Lucas that the different interests got together and prepared the act which is now in force in Ohio and which is apparently a compromise. The situation is very different from what it is in this province; we have had a Mechanic's Lien Act in force here for upwards of fifty years and it has gradually been amended and extended until the present time. We have, therefore, not only the experience of the working of this act for so many years, but we have also a large body of law from the litigation under the act, so that now the law is well settled and we know under what conditions we are working. It is true that there are some things in the act which require some consideration and revision, and they are all of considerable importance, but do not affect the general character of the act."

Mr. Urquhart also points out that if the material men were selling direct to the owners for the improvement of the owner's property it would be fair to hold the owner fully responsible, but where the credit is not given to the owner, but to the contractor who is erecting the building the situation is different. Who has the better facilities for knowing the worth and integrity of the contractor—the owner, who might be a farmer or a minister, or the material man in question, with all the sources of credit information at his disposal? Why should the owner be made the trustee for the benefit of the material man who could have protected himself, and if such legislation were ever enacted would it not result in reckless credits?

Similar Acts Not Successful

The committee appointed by the Ontario government quite recently sent Mr. B. N. Davis, barrister, to cities of Ohio and Michigan to see how the act from which this proposed act was evidently drafted was working out. His report has been made, and the following are the outsanding features of it: Mr. Davis report deals with interviews with some 12 or 14 men in the cities of the states of Ohio and Michigan, and in no instance did he find unqualified approval, and in many instances condemnation. In particular the remarks of Judge Henry A. Mandell, Dean of the Bench for Detroit and vicinity, is worth quoting. He said the act was wrong in principle; had been put through by the Lumbermen's Association, and he considered it encouraged worthless contractors, that is to say, persons that knew practically nothing about contracts, to take up the construction business, as under the act they required no credit, the supply men not looking to them, but to the owner, the result being these contractors would tender on jobs where their tenders would be below that of responsible contractors and the result was the owner got into all kinds of difficulties. The result was that responsible firms would not tender in many instances, knowing they could not compete with such a line of contractors. They also found that these contractors would make false statements, get the money and "skip." He considered the act very injurious to the class of owners who wished to erect their own medium-sized homes and who did not employ an architect or lawyer and did not understand the act. Such people generally apply to some small contractor they know, who tells them they do not need an architect and they would draw the plans. These people would thus start to build their homes, and in the majority of cases were forced to pay more than the contract price, and cited one of the last cases tried by him under the act in which a woman was building a home for herself, and in the examination of the contractor he asked him what his business was. His answer was that he was a contractor. Then his Honor asked him what he was before that, and he said he was a ditch digger. In this case the judgment was she had to pay just double the contract price.

Then, as to the handling of contracts under the act by people who did understand the act he quoted from Mr. Alexander P. Grigor, secretary of the Union Saving & Loan Company of Cleveland. So far as that company was concerned, they did not experience much difficulty, as they retained and did not pay the contractor money, but insisted on the contractor bringing into them either receipts or written waivers, when they made cheques out direct to the parties and not to the contractors. Seldom, if ever, was money paid direct to the contractor.

Elimination of Irresponsible

It has been said that this act is intended to reach the contractor who figures too cheap and does not pay his bills and should not be objected to by responsible contractors. The responsible contractor is as vitally interested in the elimination of this element as the supply dealer, and it is not by such legislation that he will be eliminated. On the other hand, whether it is intended or not the effect of this act will be the setting up of the incompetent and unscrupulous builder in business. His integrity and worth are not involved; the owner is the security.

Under the present act we have all seen instances of the supply man and retail lumberman who actually seems to prefer dealing with the small builder, whom he carries on his books because of the prices such a relationship permits him to charge. What, then, of the new bill that is proposed? Ah! What a wealth of opportunity it offers! The supply man's idea of heaven, the beautiful island of dreams where supply men and small dependent contractors play about hand-in-hand, without care or worry, with one aim and a perfect understanding, thanking God for the innocence and ignorance of owners.

But the trouble about dreams is they never work out so beautifully in real life, they never come true, quite. The lumbermen and the supply men would soon learn, as a whole, what many of them know now, and what business men in all other lines have learned early and thoroughly, that it is not good business to sell at any price to a man from whom you may have to collect by litigation. Life is too short and law courts too expensive.

Remedy in Supply Man's Hands

There is a remedy for the losses sustained by material and supply men in selling to incompetent or unscrupulous contractors, but the remedy does not lie in preferential legislation. The remedy lies in the supply man's hands now and it always will: Don't give them credit.

On the other hand, if you grant credit in good faith, and for any reason you become alarmed, make use of the act that is in force now. Of the losses that have been sustained in credits of this kind there are few instances where they could not have been prevented had the supply men availed themselves of the act as it stands.

The timid prospective builder is hard enough to woo, his nerves have had a severe strain. He must be coaxed and wheedled from under cover as patiently as a timid child. Even talk of a bill of this kind will send him flying. Take the proposed new bill out into the peaceful country side and with all honor and suitable lamentation give it decent burial.

Present Act Revised

The alternative: The Ontario government, through the committee appointed by them some time ago, asked the York County Law Association to go into the matter of the Mechanic's Lien Act and to report on same. This body has taken the present act, which they opprove of with some minor alterations as follows:

Section 7: The wording is amended to more perfectly cover the intent of this section.

Section 8, sub-section 1: As to liens attaching to leaseholds requires the owners consent and the signature of the owner on the claim.

Section 8, sub-section 2: Provides that under certain conditions where a lien attaches to a lease and where the lease expires through non-paymnt of rent the lien cannot attach on the property or lease unless the lienholder pays the rent.

Section 8, sub-section 3: Strike out the last 2½ lines. It removes the option of the judge to direct the sale of the premises at a reserved price.

Section 23: Is amended, the intent and meaning being the same and the wording being made clearer.

Section 30, sub-section 1: There is a change in the wording as to the lienholders' right to information and the standing of the accounts.

Section 30, sub-section 3: Gives the right to demand of the mortgagee terms of the mortgage and the condition of accounts instead of the contractor or subcontractor as the sub-section read before.

Sections 32 and 33: There are changes in the wording, the intent being the same.

Section 37, sub-sections 1 and 2: There are changes in the wording, the intent being the same.

Section 42: Shall not exceed 25 per cent. of the amount due at the time of the commencement of the first action to release the lien. This new section 42 takes the place of the old, which provides that the cost shall not exceed 25 per cent. of the award of the judgment.

Except in one instance, these alterations improve the present act, the main purpose and principles of which remain unchanged.

The one change they have made that is hard to understand is in section 8, sub-section 2, where liens attaching to leaseholders have no force once the rentals are in default.

Since the owner's property is increased in value by the improvements made, and since under the usual lease the owner controls the nature and amount of improvement, it is hard to see why the lien should not hold against the property as under the present act. We will be dealing more and more now with properties that are only held under long lease, and this change should be protected against, otherwise the Mechanic's Lien Act as it is proposed, amended by the York County Law Association, should have the approval of this body.

Dry Docks on the Coast are Proceeding

The Contract Record is Advised That There is no Intention of Cancelling Government Contracts

The article entitled "Cancellation of Plans for Large Public Works on the Coast" in the Contract Record of February 8, page 128, is misleading in certain respects, we are advised. From information submitted to us we are informed that the situation with respect to dry docks on the Pacific seaboard is not as serious as we had indicated. The correct situation seems to be as follows:

(a) The dry dock at Esquimalt under construction for the Public Works Department by P. Lyall & Sons Construction Co. Ltd. has not been cancelled. Work is proceeding as usual, and as far as the contractors know, there is no intention of cancelling this contract.

(b) At the Ballantyne pier works for the Vancouver Harbour Commissioners, for which A. D. Swan is chief engineer, the work is proceeding as usual and there is not the slighest intention whatever of cancelling this contract.

(c) New floating dry docks works for the Burrard Dry Dock Co., North Vancouver—This is work being financed by a private company with which are associated the shipbuilding firms of the Wallace Shipbuilding & Dry Dock Co. and J. Coughlan & Sons of Vancouver, the work to be carried out under the Dry Dock Subsidies Act. All arrangements were made for the financing of the work and the actual floating dock itself was commenced by the Wallace Co. The construction of the concrete pier and dredging of the basins, etc., have not been let. The government asked the company to delay proceeding with the work until they had sufficient time to look into the contract. It is understood that as the government are not financing this scheme themselves, but only paying a small subsidy thereon under the Act when the work is completed, the actual construction will be commenced almost immediately.

Heat Transmission Through Walls

Experiments on the Transfer of Heat and Gases Through and the Condensation of Moisture on the Surfaces of Various Wall Materials

A report dealing with experiments on the transmission of heat and gases through, and the condensation of moisture on the surfaces of, wall materials has been issued by the Building Research Board (British). The tests were carried out in a laboratory under carefully considered conditions, namely, in still air with walls consistently dry. The results obtained (given in full in an appendix to the report) are summarised below in the "Surveyor":

Heat Transmission Through Thin Walls

When heat is passing from a region of comparatively high temperature through a partition of some kind to a region of low temperature the heat transmitted can be said broadly to depend on: (1) the construction and material of the wall; (2) the character of the surface of the wall; (3) the area of wall; (4) the temperature difference between the regions of high and low temperature.

The actual heat transmitted in British thermal units in still air will then for any particular case be given by the formula

$$H = K (t_1 - t_2) A$$

where

H = British thermal units transmitted per unit time.

t_1 = Higher temperature in degrees Fahrenheit.

t_2 = Lower temperature in degrees Fahrenheit.

A = Area of wall in square feet.

K = A constant, depending upon construction and material of the wall and condition of the surface.

It will be seen then that the constant K (sometimes termed the co-efficient of transmission) will be a measure of the efficiency of the wall as a heat insulating structure, representing the overall value of the transmission in British thermal units per square foot per hour per degree difference of temperature, on the two sides of the wall.

Values of this constant K are given in the bottom line of a table which also embodies the full experimental results. These values are given below:—

Type of Wall	
9-in. plain unplastered brick wall (London stock)	0.43
4½-in. plain brick wall unplastered	0.57
4½-in. double brick wall 3-in. cavity (without ventilation	0.33
4½-in. double brick wall 3-in. cavity (ventilated top and bottom)	0.42
4½-in. rough ballast concrete 6 to 1	0.61
4½-in. rough breeze concrete	0.55
6-in. rough ballast concrete	0.57
9-in. concrete blocks with cavity in each block	0.52
4-in. hollow brick tile	0.44
4-in. ballast concrete wall outside 2-in. cavity and 4-in. coke breeze concrete inside without ventilation)	0.30
4-in. ballast concrete wall outside 2-in. cavity and 4-in. coke breeze concrete inside (ventilated top and bottom)	0.35

Thus, of the walls tested, the 4½-in. rough ballast concrete wall offers the least resistance, while the 10-in. concrete cavity unventilated wall with the inner partition of coke breeze offers the greatest resistance to the flow of heat. The latter type of wall doubtless partly owes its efficiency as a heat insulator to the porous nature of the breeze, as it is of course a well known fact that good insulators such as cork, slag wool, or wood, owe their good insulating properties to the large number of small air spaces contained within their mass.

It will be noticed that in these examples the difference in the value of K with a cavity wall when ventilated and not ventilated appears to be small; but the effect of ventilation on the transmission of heat is governed by the extent to which circulation occurs in the cavity under ordinary weather conditions. This will depend upon the force of the wind and on the difference between the temperatures of the inner and outer atmospheres. Either or both of these factors might have the effect of increasing the circulation if ventilation is provided both at the top and bottom of the cavity.

It may be said, therefore, that comparatively little is lost in the insulating effect of the wall by providing a limited amount of ventilation in the cavity, particularly if this is arranged at the base of the cavity only.

The loss of heat in all the walls may be greater under actual conditions than these tests indicate, owing to the increased cooling effect which would be produced by the action of wind or the evaporation of damp on the external surface of the wall. This might reduce the temperature of the external face of the wall by as much as 2 or 3 degrees below that of the surrounding air, depending upon the wet bulb temperature obtaining at the time.

Porosity of Building Materials

The tests on the porosity of various materials roughly consisted in drawing or forcing air, hydrogen, coal gas or carbon dioxide through slabs of the selected material. The pressure on either side of the slab was measured by means of manometers, the amount of gas forced through in a given time being determined by passing the gas through a meter. Pressure differences ranging from 16.7 lbs. per square foot to 100 lbs. per square foot were employed.

The rate of flow through any given slab was found roughly to depend upon the co-efficient of viscosity of the gas and varied in proportion to the pressure up to 80 lbs. per square foot.

In some cases specimens from different sources were tested in order to determine the degree of uniformity which could be expected due to variations in material and methods of construction.

The following materials were used:—Fletton brick, stock brick, concrete (ordinary mixing), concrete (dry mixed and rammed), coke breeze, coke breeze (rendered).

The amount of air passing through a given wall varies in proportion to a constant which depends upon the material. This constant, called the porosity, is equal to the amount of air in cubic feet that would be forced through one foot thickness of material one square foot in area by a pressure of 1 lb. per square foot in one hour.

The results show that the concrete slabs were very much less porous than the brick, the porosity being .0014 for the former and .13 and .17 for stock and Fletton bricks respectively. It is doubtful, however, whether this difference would be so marked in an actual building, since concrete made in small quantities for test purposes is likely to be more thoroughly mixed and rammed than would be the case in practice.

The porosity of the coke breeze and cement samples tested was 960 in one case and 14 in the other, the samples having been obtained from two different sources. The difference in structure was evident on inspection.

In the case of the bricks it was found that variations in results could be traced to distinct fissures the leakage through which could be felt by hand when air was forced through at the higher pressures. When these leaks were stopped up the porosity was diminished by some 20 per cent.

It would appear, then, that leakage through defective joints may be far more important than the porosity of the actual material used.

Porosity of Wall Plaster

Some preliminary experiments were made with plaster applied to coke breeze blocks, but unsatisfactory results were obtained owing to the low porosity of the breeze foundation.

For the main tests the plasters were applied to the expanded metal foundation. The slabs were finished on one surface so that one-half the area of one surface was smooth, the remainder half being left rough. The back of the slab was also left in the rough state.

Dealing with this series, it is shown by a table in the report that plaster materials generally are relatively porous except for the fine setting coat which in the case of common plaster makes the material twenty times as resistant to the passage of air. The results are given for the actual thickness of plaster tested.

Though the results show that the various materials differ in porosity the difference does not seem of great importance in view of the small quantity of air which would pass through the material of a wall in practice.

Assuming a room 15 ft. by 10 ft. by 8 ft. with the longer wall exposed to an air pressure of 1 lb. per square foot which corresponds to a strong wind, and taking a porosity of 0.2 for a 9-in. wall and 0.2 also for ¾-in. plastering, and taking 0.1 as the combined porosity of the two, only 12 cubic feet of air per hour will pass through the wall. This is only 1 per cent of the capacity of the room.

The effect of a crack in a 9-inch wall has been estimated by a calculation of the amount of air which will be forced through a fissure one-sixteenth of an inch wide and about a foot in length, by the same pressure. This would be in the neighborhood of 200 cubic feet per hour. Thus the small crack will pass many times the amount of air which will percolate either through the bricks and plaster or through an unplastered wall. In most rooms natural ventilation of something like one change per hour will occur often with doors and windows closed. For the room in the example this amounts to 1,270 cubic feet—hence it will be seen that percolation through brickwork and plaster is negligible.

The results on porosity experimentally obtained show that the material of the wall has very little to do with the stuffiness which is sometimes stated to be found in concrete cottages. The material itself can have nothing to do with this which, if it really exists, is probably due to the lack of provision of ventilating openings necessary in a building entirely constructed of concrete. The plaster itself makes a great difference as also do the finish and surface treatment.

Moisture Condensation on Various Surfaces

The investigation into the condensation of moisture on various surfaces proved extremely difficult to carry out and the results were not definite. The main fact brought out was that the nature of the surface rather than the material was of importance. The smooth surfaces showed far more condensation than the rough, as was to be expected.

Moisture Content in Concrete

Effect of this Factor on the Expansion and Contraction of Plain and Reinforced Concrete

While the properties of concrete have been investigated for many years, attention has largely been given to considerations of strength alone. Aside from the action of direct load, deformations are produced in concrete by changes in temperature and in moisture content. With reference to temperature changes in reinforced concrete, it is well known that concrete has practically the same coefficient of expansion as steel, so that the two materials contract or expand together. Moisture content, on the other hand, has the undesirable property of affecting concrete alone. Concrete, like wood, clay, and some other materials, expands when it absorbs moisture, and contracts when it is dried. Steel has no such action. After the concrete is poured the steel remains unchanged with changes in moisture conditions, while concrete ordinarily shrinks a considerable amount. Aside from the stresses set up in steel and concrete by the shrinkage of the latter, the resulting formation of cracks large or small will produce a condition which may be favorable to the corrosion of the steel or the disintegration of the concrete after repeated changes from dry to wet condition.

Bulletin No. 126 of the Engineering Experiment Station of the University of Illinios, entitled "A Study of the Effect of Moisture Content upon the Expansion and Contraction of Plain and Reinforced Concrete," contains some of the results of experiments made by Torata Matsumoto, a graduate student in Theoretical and Applied Mechanics at the University of Illinois, in 1918. Owing to his years of experience as an engineer on harbor works on the Island of Formosa, he was particularly interested in the question of the durability of concrete exposed to sea air and to the conditions found in a tropical climate. It is felt, however, that the results obtained apply to our ordinary conditions and may have many practical applications.

The tests which are described were made to investigate the amount of shrinkage which may be expected in a mortar or a concrete the relation between the change of moisture content and the change of length of these materials, the difference in shrinkage of plain and reinforced concrete, and the internal stresses set up in the latter. For purposes of comparison with the results obtained with concrete, a few tests were made on the effect of the absorption of water sandstone and limestone.

Conclusions

The conclusions which are arrived at as a result of the investigations are as follows:

1. Concrete expands when it absorbs moisture and contracts when it is dried. Concrete of a 1:2:4 mixture is likely to contract during hardening as much as 0.05 per cent in an ordinary structure.
2. Contraction of concrete by the loss of moisture causes stress in the concrete when it is restrained by an external force. The amount of this stress is not as small as is generally supposed.
3. The shrinkage stress caused in the steel in reinforced concrete may reach the usually accepted working stress of steel when the amount of reinforcement is less than 1.5 per cent.
4. The shrinkage stress developed in 1:2.4 concrete may reach the ultimate tensile strength of the concrete when the amount of reinforcement is greater than 1.5 per cent. With richer mixture the increase in shrinkage stress may be relatively greater than the increase in ultimate strength.
5. The greater the percentage of reinforcement the greater the tensile stress that may develop in the concrete, and concrete having a higher percentage of reinforcement than 1.5 per cent is likely to have cracks formed unless proper provision is made.
6. In reinforced concrete out of doors, subject to alternate wet and dry conditions, cracks may readily be formed under the repeated stress which is nearly equal to the tensile strength of the concrete.
7. Reinforced concrete does not appear likely to be a durable material in a place where a corrosive influence on steel, such as sea air, is active, unless proper protection against the formation of shrinkage cracks is made.
8. It is suggested that the prevention of shrinkage stress in concrete might be accomplished in two ways, either by finding a cement giving less expansion and contraction, or by the use of a perfect waterproofing treatment.
9. It may be expected that an integral waterproofing compound might lessen the change of volume for a short time, but it would not prevent the final diffusion of moisture with consequent change in volume.

It is Not All Work With the Montreal Builders' Exchange

The Montreal Builders' Exchange is something more than a business organization—it has a social side, the directors being of opinion that this aspect of its activities makes for the solidarity of the exchange. The annual curling bonspiel is the social event of the year. It was held on February 16 and 17 and wound up by a supper on the evening of the latter date at the Windsor Hotel, when the prizes were distributed. Over one hundred were present. The presentations and speeches were varied by a short musical programme, which included community singing. Messrs. K. D. Church and Douglas Bremner acted as joint chairmen.

The first part of the evening was occupied by a speech by Mr. J. M. Barss, superintendent of the Boys' Home, Shawbridge, P. Q. In an eloquent address, he outlined the work being done with the object of restoring lads who have gone astray, to make first class citizens out of those who have lost their moral balance and to fit them for places in the building and other industries. A collection for the Home resulted in over $200 being contributed.

Mr. J. Ballantyne and Mr. W. E. Ramsay briefly commended the work of this institution.

Then came the presentation of prizes and three or four brief speeches dealing with the events of the contest. Mr. J. P. Anglin, with whom the idea of the bonspiel originated, suggested that they should encourage the idea of securing rinks from the different trades or firms—such as his own rink had been—with a view to increasing the interest. This was the second bonspiel and it had attracted larger entries than the previous contest.

The prizes were presented to the winners by Messrs. J. P. Anglin, C. Smallpiece, W. E. Ramsay, A. Bremner and J. Grieve. The cup donated by the Builders' Exchange was won by the rink of architects consisting of Messrs. W. B. Hutchison, C. A. Hutchison, A. C. Wood and D. F. Wood of the firm of Hutchison & Wood. Besides this cup, individual cups were presented to the members of the rink, the thistle forming a part of the design as a compliment to the Thistle Club of which the winners are members. The winners of the second prizes were Messrs. J. Duthie, E. B. Evans, G. Blackwell, and A. W. Allyn, who are identified with contracting, it being jocularly remarked that contractors, of course, had no chance with the architects, who always got the better of contractors The prizes consisted of walking sticks. The first consolation prizes—safety razors—went to the rink composed of D. W. Ross, W. L. Sample, R. G. Hutchison and A. K. Hutchison, while the second consolation prizes—caps—were won by Messrs. R. F. Dettmers, T. Glen, J. Yelland and W. G. Richardson.

After the presentations, Mr. J. B. Carswell, Toronto, President of the Canadian Building and Construction Industries Association, in a short speech expressed the opinion that the corner had been turned in their industry. The association which he represented had a great work before it—some big problems to solve, but the executive was composed of men equal to the task. As to labor, the contractors were of sufficient calibre to dominate the situation.

Mr. E. G. Brosseau, president of the Quebec Builders' Exchange, emphasized the necessity of co-operation between builders' exchanges in order to effectually carry out the objects for which they were established.

At the termination of the speeches, Messrs. James Young, P. S. Ferguson, J. A. Anderson and other skips of the rinks challenged Mr. Anglin's rink to play at a later date for wagers to go to the Boys' Home.

Well Equipped Studio in Montreal for Production of Ornamental Plaster

About four years ago, Mr. Anthony de Giorgio, general manager of de Giorgio, Limited, contractors for plain and ornamental plastering, came to Montreal from the United States as foreman in charge of a large plastering contract. He did not go back as he believed that there was an opportunity for building up a large business—and his optimism has proved correct. Endowed with the artistic temperament of his race, and provided with the skill secured through many years' experience in the United States, he started the Decorative Plastering Company on Benoit Street. That venture proved a success, and in May last he purchased premises at 12 Lagauchetiere Street East. These have been entirely remodelled, and converted into a well-equipped studio. The business is now carried on under the name of De Giorgio, Limited. In addition to being contractors for plain and ornamental plastering, the company carry out contracts for all artificial stones for interior and exterior work; scale models and antique reproductions; models for stone, wood and metal; and architectural sculpture. The company make a speciality of ornamental plastering from architects' plans, and the studio has been laid out for this purpose.

The ground floor is occupied by the general offices, a portion of the walls here and on the stairways being utilized to illustrate different classes of plaster work. Thus we have specimens of Caen stone, sand finish, sand finish in cement, smooth finish. Three varieties of stucco for houses are shown, with specimens of rough cast and cement rough cast. These specimens are for the purpose of showing the various effects of the finishes to prospective clients.

The first floor is the studio proper—a very spacious room, so constructed as to receive light from a skylight over 30 feet above the floor level. For this purpose a considerable section of the flooring on the next storey has been cut away, thus forming a very large light well. The models are made up on a wide wooden easel, 30 feet high, and so built as to enable the models to be raised to any height desired up to 30 feet. The purpose of the easel is to exhibit to architects and others the appearance of models at different heights, in order to secure the best effect. Models of various jobs carried out are ranged around the walls. The supply of plaster is kept in a plaster box, on the next floor and is fed to the workmen through a chute fitted with a small wooden door. When plaster is required, the workman opens the door and takes the required quantity. The plaster box holds eight barrels. The studio is equipped with large benches, one with a solid marble top.

On the top floor, which in effect is a wide gallery with railings on three sides, there is room for a large number of supplies. Samples of mouldings, freizes, caps, brackets, etc., in various sizes, all numbered, and in a great variety are displayed on the walls—the floor will in fact, be principally used as a show room.

An electric elevator has been installed, running from the basement to the top floor, for the purpose of conveying supplies. The bulk of the supplies are stored in the basement. Each floor has lavatory accommodation and a water supply.

The jobs carried out include plastering, some of it of a very ornamental and artistic character, at the National Club, Cherrier Street, Montreal; the Italian Church, Mile End, Montreal; St. Augustine Church, Notre Dame de Grace, Montreal; remodelling of St. Louis de Gonzague, P. Q.; the Belmont Theatre, Mount Royal, Montreal; the Papineau Theatre, Papineau Avenue, Montreal, and the Jewish Synagogue, Fairmont Avenue, Montreal, also Midway Theatre. The Contracts in hand are the Plaza Theatre, St. Hubert Street, Montreal, models for Hutchison & Wood, architects for the Labelle Building, St. Catherine Street East, Montreal, and Vickers Limited.

A portion of the studio of the firm of Giorgio, Ltd., who have produced some of the most ornamental and artistic plaster decorations in Montreal buildings

The Contract Record's

Weekly House Suggestion No. 11

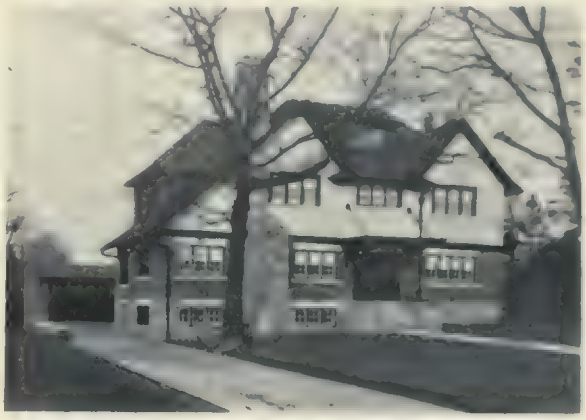
The attractive brick and stucco home shown in the accompanying illustration was completed recently for Mr. A. N. Dudley, at 106 Poplar Plains Rd., Toronto.

The ground floor plan comprises living room, dining room, den, conservatory and kitchen. The living room is a large room, 26 ft. x 18 ft., immediately to the left of the front entrance, and is connected with the conservatory by French doors. The latter room is beautifully situated, overlooking the ravine. The dining room is to the right, with the pantry conveniently located between this room and the kitchen. The den is connected with the living room and hall. The dining room is panelled to a height of 6 ft., with wooden panels of walnut. The living room is finished in mahogany, with a large mahogany mantel and beam ceilings, the tone of the decorations being ivory white. The den, halls and vestibule are finished in quarter-cut oak. The den complete with mantel, bookcases and beam ceiling. The conservatory is attractively finished in French grey and the kitchen and pantry are enamelled white and tiled to a height of 5 ft.

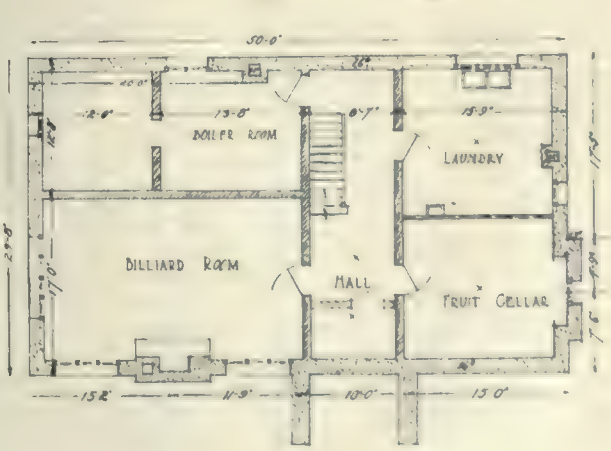
The bedroom flat comprises roomy bedrooms, sunroom and two bathrooms, one being for domestic help. Both bathrooms are finished in 3 in. x 6 in. tile; the main bathroom is floored with 1 in. hexagon tile, the woodwork in both rooms being done in white enamel. The main bedroom opens off the main bathroom and is connected also to the sunroom. This latter room, as well as two other bedrooms, are finished in white enamel with mahogany doors. The maid's bedroom and bathroom are finished in birch stained mahogany to match the balance of the trim.

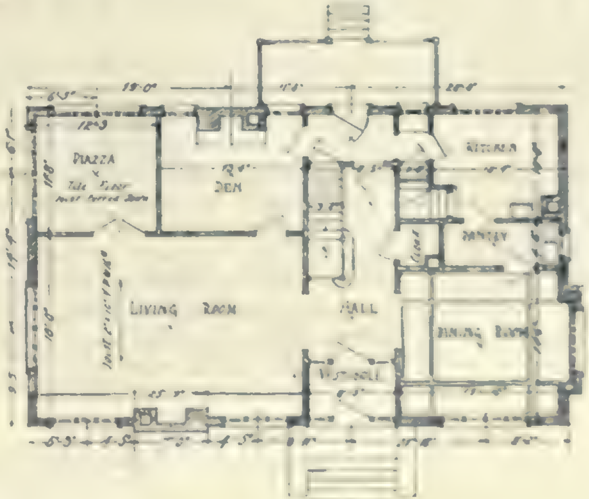
The electric wiring system of the house is elaborate, there being three large electric grates, service outlets for vacuum cleaner, standing lamps, etc., besides numerous conveniently located lighting switches. There is a garage situated at the rear of the house, with sufficient space to accommodate two cars and workbench.

The basement contains the usual accommodation for coal and fruit storage, heating plant, etc., besides a large billiard room, the same size as the living room, which is finished in fir, stained dark.



The masonry work was done by Messrs. Hawken & Kelly, the stone being Port Credit piebald and grey. Milton pressed buff brick was used on the ground floor, with stucco on brick for the first floor. The woodwork was done by Messrs. Weller & Company; the plumbing supplies were standard sanitary and were installed by I. Maude; the heating plant is a Spencer hot water, and was installed by Mr. W. H. Miles; the plaster work was done by Messrs. Boyce & Son. The architect was Mr. J. A. Thatcher, 24 King St. W., Toronto.





No. 36

Canada's Contractors—Chas. Bentall

Mr. Chas. Bentall, R. P. E., general manager of the Dominion Construction Co., Ltd., Vancouver, is a structural and mechanical engineer, who has devoted himself to general contracting ever since coming to Canada, and in this work has had a varied and successful experience. Born in England, Mr. Bentall was trained there in his profession. For years he was with the British Thompson-Houston Company, an engineering concern with worldwide reputation. Coming to Canada in 1907, Mr. Bentall gravitated to Vancouver, where he joined the staff of J Coughlan & Sons, at that time exclusively in the supplying and fabricating of structural steel. In his work, Mr. Bentall was responsible for the designing and erection of many important steel frame structures erected in Vancouver during the period when many tall buildings broke the skyline. One of the principal steel structures whose design was in his charge was the World building, now known as the Tower building. This block, at one time was claimed to be the tallest building in the British Empire. Its feature is a massive tower, containing suites of offices making a total height of eighteen storeys above street level.

When Mr. Bentall left the Coughlan Company to engage in business for himself, he had become chief engineer for the company. On leaving he entered a partnership of consulting engineers, composed of Messrs. Wilson, Lake and Bentall. He continued in that connection until 1912, when he joined the staff of the Dominion Construction Co., Ltd., as chief engineer. He has been with the company ever since, and with Mr. John Tucker, whose sketch appeared in last week's issue, now controls it. He became general manager two years after entering the company.

Mr. Chas. Bentall

Opportunities For the Development of the Ceramic Industry in Canada

That opportunities exist in Canada for the development of a certain section of the ceramic industry, such as exist in no other part of the world, was made plain by Dr. P. H. Bates, chief of the division of structural materials of the Bureau of Standards, Washington, in an address in Convocation Hall, University of Toronto, on February 18, on "Structural Ceramic Products," during which he characterized the present era as a truly artificial stone age, with respect to the strides made in the manufacture of tableware, brick and various forms of tile.

Dr. Bates gave a very technical, though thoroughly comprehensive lecture on the methods employed in the manufacture of ceramic products, tracing the development from the earliest times, when clay vessels of crude shape and materials were used, to the present, which found that the industry in many directions had reacher a very high degree of perfection. The ceramic industry was not as the layman understood it, a decoration of pottery, but a chemistry of the silicates. By experiment it had been found what clays were best fitted for dishes, tiles or bricks; and it was the mixing of two or more clays in the correct proportion that had enabled the obtaining of good results.

Search for Non-Expanding Brick.

One of the most important features of the Bureau's research work was to attempt to secure a brick which resisted fire to such a degree that no appreciable expansion occurred. It had been found that in many instances, the brick or cement covering the steel in skyscrapers was not sufficient to prevent buckling, even in light fires, and as the ability of the fire brick to stand up meant everything, it was all-important that buildings received the best protection. This was a question of extreme moment, said Dr. Bates, and the Bureau of Standards was conducting a series of tests with concrete with this point in view.

U. of T. Engineering Research Bulletin

A particularly interesting publication is Bulletin No. 2, 1921, of the School of Engineering Research, Faculty of Applied Science and Engineering, University of Toronto. This bulletin is the result of a variety of research problems that have engaged the attention of university professors, graduates and undergraduates in the recent past and marks a decided step in the progress of university education. Of particular interest to our readers is an article by Professor Peter Gillespie on "The Imhoff Sewage Tank in America; A Decade of Operation Reviewed". Another valuable paper is entitled, "Investigation of the Preparation of Concrete Mixtures", by Professor Gillespie and A. R. Duff. A third, by Professor C. R. Young, is entitled "True Net Sections of Rivetted Tension Members". A number of papers on electrical subjects are contributed by Professor H. W. Price and C. K. Duff, and another group of papers on aeronautical subjects, by J. H. Parkin, with whom was associated a number of research students. The work of the School of Engineering Research, if one may judge by the present publication, is destined to be of very real commercial value to Canadian industries.

Mainly Constructional

East and West—From Coast to Coast

The B. F. Sturtevant Company have issued Bulletin No. 246, entitled "Generator Cooling Apparatus".

Trenton Hardwood Flooring, Limited, with head office at Trenton, capital $49,000, to manufacture and deal in hardwood flooring.

The Ontario Granite & Marble Dealers' Association held a two-day convention at the Carls-Rite Hotel, Toronto, on Feb. 22 and 23.

Fire losses in Canada during the week ended February 15, are estimated by the Monetary Times at $1,568,450, compared with $756,500 the previous week.

The carpenters' union at Ottawa has reached an amicable settlement of their wage dispute with the employers, a wage rate of 70 cents an hour being agreed on until May 1, 1923.

The handsome residence of Mr. Wm. Lyall, president of the Lyall Construction Company, at Montreal, was completely destroyed by fire recently. The fire was caused by an explosion of the furnace.

Damage estimated at $10,000 was done to the plant of the Queenston Quarry Company, at St. David's, near Niagara Falls, recently by fire. The damage which concentrated in the crusher house and bins, will be repaired at once.

At the regular weekly meeting of the Toronto Branch of the Engineering Institute of Canada, last week, Mr. J. B. Carswell, of the Carswell Construction Co., read a paper on "Rail Carbon Steel" which pointed out the great economic advantage to the railways and the steel industry by the conversion of rails, no longer fit for use as rails, into round or square rods, for concrete reinforcing.

The gold medal, presented annually by the Royal Institute of British Architects, of London, England, to a distinguished architect, was awarded this year to Mr. Thomas Hastings, member of the firm of Carrere & Hastings, of New York city. It has been the custom to present this medal to British and foreign architects alternately. Mr. Frank Darling, of Toronto, is a holder of this medal.

A plant is being erected on Royce Avenue, Toronto, for the manufacture of the new self-locking concrete slab for construction work, by the Self-Locking Concrete Wall Company, Limited. There are 68 plants at the present time throughout the United States and Canada manufacturing this product. Mr. E. H. Ross, Managing Director of this company, has established an office in this city, for the purpose of organizing the sale of the product throughout this district.

It is stated that Labor in the West will firmly oppose the 25 per cent wage reduction proposed by the employers at the recent convention of the Western Building & Construction Industries, at Calgary. The following new scale was drawn up at the convention: Bricklayers, 90 cents; plasterers, 85 cents; carpenters, 70 cents; plumbers, 85 cents; steamfitters, 85 cents; sheet metal workers, 75 cents; painters, 70 cents; electricians, 75 cents; stone-cutters, 75 cents, and structural steel workers, 90 cents per hour. For laborers a sliding scale of from 40 cents to 50 cents was adopted. A resolution requests that labor will co-operate by agreeing to work longer hours per day during the favorable working season.

It is announced that a start will be made at Montreal on the preparation of a general plan of the city, showing width and levels of streets, location and dimensions of sewers, gas and water pipes and all public services. An idea may be had of the work involved in the preparation of a plan of this sort from the estimates of city officials who claim that this work will take ten years to complete and will cost between $600,000 and $800,000. Under the present system parties have to be sent out to obtain data on the above mentioned services every time a civic works project is to be carried out. A general plan would keep this information ready at hand at all times and eliminate the expense of obtaining this data on every proposed development.

Mr T. B. Macauley, president of the Ile Perrot Bridge Commission, in his report, presented at the first annual meeting of the above commission, at Montreal recently, announced that work will be commenced within the next few months on two bridges, to connect Ile Perrot with Ste. Anne de Bellevue, on one side and Vaudreuil on the other. The commission will remain in existence until the construction of the two bridges has been carried out. The provincial government has assured the commission of financial assistance to the extent of $600,000 and the Dominion Government has promised a grant of $150,000 towards these projects. The Dominion Department of Public Works has loaned the services of one of its engineers, Mr. V. Denis, to draw up designs for these two bridges, and he is being assisted in this work by several consulting engineers. Mr. Gustave Boyer is secretary of the new commission and Lt.-Col. F. S. Mackay, mayor of Dorion, is treasurer.

Personal

Messrs. Nichols, Sheppard & Colthurst, Architects & Engineers, 32 Sandwich St. W., Windsor, Ontario, announce that after March 1st, they will be located in their new offices, Dowler Bldg., Sandwich St. W., Windsor, Ontario.

Col. A. MacDonnell and Gen. J. Stewart, of Grant, Smith & Co. & MacDonnell, Ltd. of Vancouver, B. C., sailed recently from New York for England, the first step on their trip to the Gold Coast, Africa, where their firm has secured a large contract to construct docks, breakwater and railway for the British Government.

Mr. G. P. Graham has been appointed district engineer of the Asphalt Association, with headquarters in Toronto, Ont. and Albany, N. Y. Mr. Graham will represent that district comprising the provinces of Ontario and Quebec and the northern part of New York State. He was formerly deputy city engineer of Albany, N. Y., and is a graduate of the Rensselaer Polytechnic Institute, of Troy, N. Y.

Messrs. Mogan & Walton, engineers and general contractors, have opened an office at 34 Yonge St., Toronto. Both members of the new firm were formerly on the staff of the Russell Construction Company, Ltd., of Toronto. Mr. James T. Mogan, B. A. Sc., is a graduate of the School of Science (1915), University of Toronto. Mr. Melville R. Walton, B. S., is a graduate of the George Washington University, Washington, D. C.

Mr. Thomas Adams, former town planning adviser to the Commission of Conservation, has returned to Canada after a five months' absence in England, where he has been associated with Thomas Mawson, the famous landscape architect, in town planning work in London, Northampton, Windermere, Blackpool and other cities. Mr. Adams has been engaged to give a course of lectures on town planning at the Massachusetts Institute of Technology, and in the department of landscape architecture at Harvard university.

Obituary

Mr. Thos. B. Glennon, a member of the Montreal Harbor Board for 43 years, died recently at his home, 87 Jeanne Mance St., Montreal, from an attack of heart failure.

CONSTRUCTIONAL ACTIVITY

Period of February 22 to February 28, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Acton Vale, Que.
Construction of mechanical filtration plant is contemplated by Town Council. J. C. St. Pierre, secy.

Burlington, Ont.
Town Council contemplate construction of pavement on Brant St. J. J. MacKay, Engr., Home Bank Bldg.

Chicoutimi, Que.
Gravelling road from Lake St. John to Bagotville and Hebertville to Jonquieres is contemplated by Prov. Govt., Dept. of Roads. G. Henry, Engr., Roads Dept.

Hamilton, Ont.
By-law has been passed authorizing construction of sewer from T., H. & B. tracks to junctions of Hamilton and Ancaster Rds. to cost $32,000 for City. E. R. Gray, Engr.

Suburban Area Cmsn., Court House, Hamilton, will improve Mount Albion Rd. at cost of $25,000.

Construction of watermain on Mt. Hamilton at cost of $14,000 is contemplated by City Council. E. R. Gray, Engr.

Barton Twp. Council, Court House, Hamilton, plan construction of water and sewerage system on Mountain Top.

Mitchell, Ont.
Construction of municipal drain at cost of $10,539 is contemplated by Hullett Twp. Council. John Rogers, Engr., Mitchell, Ont.

Montreal, Que.
Construction of sewer on Ogilvie St. from Lanoraie St. to Stuart St., and Birnam St. to Allen St., is contemplated by City Council. S. Fortin, Engr.

City Council plan construction of sewer on Anvers St. from St. Adele to Lanoraie Sts. S. Fortin, Engr.

Ottawa, Ont.
Construction of asphalt pavement on George St. from Dalhousie to Cumberland Sts. is contemplated by City Council. A. F. Macallum, Commr. of Works.

Renfrew, Ont.
Town Council will reface road on Raglan St. at cost of $18,000. John R. Stewart, Engr.

Rigaud, Que.
Construction of macadam road on Upper Filas Road is contemplated by Council. Nelson Brule, secy.-treas.

St. Hyacinthe, Que.
Construction of road from St. Hyacinthe to St. Lambert is contemplated by Prov. Govt., Dept. of Roads. G. Henry, Engr., Dept. of Roads.

Tara, Ont.
Arran Twp. Council plan draining Martin Swamp. C. A. Speer, Tara, Ont.

Wiarton, Ont.
Keppel Twp. Council contemplate draining Long swamp and reclaiming 1,800 acres. Geo. Atkey, clerk, Wiarton.

Woodbridge, Ont.
Construction of waterworks system at cost of $30,000 is contemplated by Town Council. James, Proctor & Redfern, Ltd., Engrs., Excelsior Life Bldg., Toronto.

CONTRACTS AWARDED

West Kildonan, Man.
Contract for sewer fittings for Municipality of West Kildonan is awarded to Braid & McCurdy, 136 Portage Ave., E., Winnipeg.

City Council awarded contract for sewer castings to Magnet Metal & Foundry Co., Ltd., Watt & Chalmers Ave., Elmwood, Winnipeg.

Railroads, Bridges and Wharves

Cacouna Village, Que.
Construction of concrete bridge is planned by Council.

Chicoutimi, Que.
Construction of bascule bridge at cost of $500,000 is contemplated by Prov. Govt., Dept. Pub. Works. I. E. Vallee, Engr., Pub. Works Dept., Parliament Bldgs., Quebec.

Hamilton, Ont.
Construction of subway under incline on Wentworth St. is contemplated by City Council. E. R. Gray, Engr.

High Falls, Que.
Bridge costing $12,000 is being constructed by day labor by Municipal Council.

Ottawa, Ont.
Ottawa Electric Rly. Co., Albert St., plan construction of extension on Bronson Ave. from Gladstone Ave. to the Driveway. Fred D. Burpee, Mgr.

St. Edwidge, Que.
T. J. Faureau, Mayor, has plans and will receive tenders, no closing date set, for construction of bridge.

St. Louis, Que.
Chs. Ouellet, St. Louis, secy. Municipal Council, has plans and will receive tenders until March 6th for construction of steel and concrete bridge. Plans also with I. E. Vallee, Engr., Pub. Works. Dept., Parliament Bldgs., Quebec.

CONTRACTS AWARDED

Chilliwack, B.C.
Wm. Greenlees, 592 Seymour St., Vancouver, has general contract for construction of bridge costing $19,000 over Vedder River for B. C. Electric Co., H.O., Carrall and Hastings Sts., Vancouver.

Public Buildings, Churches and Schools

Alma, Ont.
J. E. Farrelly, R. R. No. 1, Alma, secy. Trustee S. S. No. 11, Peel Twp., has plans and will receive tenders until March 10th for erection of school to cost $5,000.

Almonte, Ont.
Rev. W. E. Cavanagh, Parish Priest, has plans and will receive tenders until March 6th for erection of convent to cost $60,000.

Annapolis Royal, N.S.
F. W. Harris, Town Clerk, has plans and will receive tenders until March 10th for erection of town hall to cost $25,000. J. G. Johnson, architect, Kentville, N.S.

Athens, Ont.
A. Stuart Allaster, architect, King St., Brockville, Ont., is preparing plans for high school to cost $50,000 for Athens High School Bd.

Birch Cliff, Ont.
Erection of high school costing $125,000 at stop 29, Kingston Rd., is contemplated by Scarboro High School Bd., Birch Cliff. Burden & Gouinlock, architects, 101 Kink W., Toronto.

Burden & Gouinlock, architects, 101 King W., Toronto, are preparing plans for school to cost $60,000 for School Section No. 10, Birch Cliff.

Carleton Place, Ont.
Erection of high school is contemplated by School Bd. C. H. Abbott, secy.

Clarenceville, Que.
Erection of church hall is contemplated by Baptist Church Congregation. W. Madigo, architect and trustee.

Copper Cliff, Ont.
Vaux Chadwick, 132 Church St., Toronto, has plans and will receive bulk tenders until March 9th for rebuilding school for Copper Cliff School Bd. Plans also at the Town Hall, Copper Cliff.

Coquitlam, B.C.
Erection of school costing $17,000 is contemplated by Coquitlam School Bd. Gardiner & Mercer, architects, 827 Birks Bldg., Vancouver.

Daveluyville, Que.
Erection of addition to convent costing $8,000 is contemplated by Sisters de Assumption.

Edmonton, Alta.
Erection of isolation hospital is contemplated by City Council.

Grand Point, Man.
Plans have been prepared by Gilbert Parfitt, architect, Parliament Bldgs., Winnipeg, for school for Coquart School District, Grand Point, Man.

Hafford, Sask.
Tenders will be called for erection of addition to school for Hafford School District. O. Zerelick, secy.-treas.

Hickson, Ont.
Chas. W. Rowe, secy. School Bd., will receive tenders until March 25th for erection of school to cost $16,000. Plans with F. W. Nicholls, architect, Temple Bldg., Brantford.

La Salle, Man.
Gilbert Parfitt, architect, Parliament Bldgs., Winnipeg, has prepared plans for

ESTABLISHED 1886

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National Wealth and Character—How Develop It?

In his report to the Executive of the Provincial Builders & Supply Association, Mr. Geo. S. Gould of London, Ont., expressed the opinion that agreements between contractors and labor were of no practical benefit, and suggested that the time may have arrived to consider the advisability of discontinuing all negotiations with organized labor (collective bargaining) and "not allow them any choice regarding the manner in which we propose to conduct our business or manage our affairs."

This doesn't read just right—hasn't got the right ring. Indeed, we incline to believe Mr. Gould wasn't overly serious in his suggestion.

Most contractors are ready to admit that they have found "labor" difficult to handle, not too amenable to reason, inclined to be vindictive, lacking in enthusiasm for their employer's interests, and many other things equally bad. But the question at issue is not "How can we 'get back' at labor?" but rather, "How can we improve this condition and prevent periodic recurrences of it?" Because Labor has pinched Capital during the last few years is surely not a sufficient reason why Capital should try to degrade Labor.

Our problem is to stabilize the building industry, having in mind the greatest benefit to both Capital, Labor and the Public. The only way to accomplish that end is for the contactor, labor and the public to co-operate. It's all very well to say, in effect, that its no concern of Labor how Capital conducts its business. Labor turns around and says "It's no concern of Capital how I conduct my business; I'll not work at all; I'll strike." The result is that industry is badly disorganized when either party takes this independent viewpoint, and they both suffer—along with the public.

The plain fact is that neither Capital nor Labor, neither employer nor employee, can prosper and make real progress without the other doing the same. Above all, we must remember that, whether employers or employees, we're all human beings, created for the same purpose, with much the same aims and aspirations, if they are closely analyzed. This life's work is not a mere struggle between wealth and poverty—at least, it ought not to be. It ought to be—and is—a co-operative, unified movement, between the men of our nation to build and develop and create national wealth and national character.

As to agreements—because one man has less of this world's goods than another, is that reason for denying him the right to a little peace of mind—the peace that only comes with the knowledge that the future, to some extent, is assured? Animals only are content with such treatment and in return for the concession don't we guarantee them food and housing as long as they live?

Labor is either animal or man. If animal—which God forbid—then we must guarantee the same ample supply of food, care and comfort every day in the year as we give our horses and cattle, cats and dogs. If man, then we must treat him like one of ourselves and look upon his lack of knowledge of conditions, his vindictive tendencies, his excessively sensitive attitude of mind as mere characteristics.

Can we not, with advantage, revise our phraseology? We say labor works **for** capital. Let us, rather, say that labor works **with** capital. When these two become partners, each working for both, there will no longer be any suggestion of "**my** own business."

So much for the moral side; there is also the commercial side. There is nothing assures success in big things, later on, so much as success in little things today. There's nothing encourages a workman to improve his condition, in the future, so much as a little improvement at the moment. "Prospects," even in the most nominal way, is an incentive to which every man responds. The employer who aims to see his workmen prosperous and contented reaps big dividends in the way of better work and more of it.

Logical Campaign for Fair Rentals

A newspaper despatch states that "a campaign for Fair Rentals has been started by the G.W.V.A. in St. Catharines."

What form the campaign will take the despatch does not state, but we incline to the opinion that it will be useless, and at best only temporary, unless the only reasonable course is followed—increase the supply of homes.

What should we think, to-day, of a doctor who, called upon to treat a patient suffering agonies with a diseased appendix, did nothing beyond prescribing a hypodermic to relieve the pain temporarily? Unless we get at the **cause** of the trouble, there can be no lasting relief, and this applies equally to appendicitis and high rents. The only relief from high rents is more homes or reduced population—and our population is increasing at a good steady rate.

As we said in our last issue, the situation with regard to the shortage of houses is critical and, being cumulative, must soon seek its own solution whether or not we are satisfied that we have reached the bottom in the matter of prices. A house building storm must inevitably burst on us in the very near future. If the G.W.V.A. numbers within its ranks any members of the various trades, it would seem to be the part of wisdom to discuss whether the end they have in view might not be brought about more quickly by a concession, temporarily, we hope, in the way of wages so as to hurry this storm along. We venture to predict that any concession in this direction will quickly be made up in the reduction of rentals that must surely follow reversal of the present conditions of supply and demand.

Suspension Bridges Have Long Life

Examination of Bridge Cables Shows Wires Almost Perfectly Preserved If Proper Care Has Been Taken — No Indications of Rust in Protected Cables

In view of the decision of the Board of Engineers of the Windsor-Detroit bridge to use the suspension type for the new bridge over the St. Clair River, it seems to be an opportune time to bring to the notice of the public in general and the engineering profession in particular the result of an inspection of the cables of some of the large bridges of this type. Doubtless the board was influenced in their selection by the excellent service these bridges have given in the past and the promise of a still greater service in the future.

One of the bridges, the Williamsburgh, over the East River at New York City, was built in 1902 and on account of the success experienced up to that time in the use of a "slushing oil" to protect the wires in the cables from rusting, this method was employed. Each cable was wrapped with four thicknesses of canvas heavily coated with the same kind of bituminous material as filled the spaces between the wires. The whole cable was then covered with a 1/16 in. steel sheathing. This method, however, did not prove as satisfactory as the method used to protect the Brooklyn bridge cables which were wrapped with a galvanized wire.

It was due to the corrosion of the steel sheathing that the re-wrapping of the Williamsburgh bridge cables was decided upon. It was found that the canvas covering had become hardened and allowed moisture to come in contact with the wires of the cable. Slight indications of rust were observed in several places but the strength of the cables was in no way impaired and they are now being closely wrapped with No. 9 Norway iron wire, galvanized.

Galvanized Wire Protection

This was the method employed in protecting the cables of the Brooklyn and Manhattan bridges. The cable wires in these two bridges are galvanized and examination from time to time has shown no indications of rust at any point in the cables. Some trouble has been experienced with the slipping of the cable bands on the Manhattan bridge but a modification in the details of the bands has remedied this defect. In replacing the bands a short section of the cable was unwrapped, wedges driven between the wires and the interior of the cable examined.

The condition of the structural steel in the bridges was also examined and although as much as eight or nine years has elapsed between paintings, the steelwork of both the above structures is considered in perfect condition.

A very fine example of the life of wire cables is found in the bridge built across the Ohio River at Wheeling, West Virginia, in 1846. This bridge is 1010 feet long, of the wire cable suspension type, and was later reconstructed using most of the original cable which is said to be in perfectly good condition to-day after being in service for seventy-six years.

Numerous other examples of the long life of wire cables are available and they seem to point out that the life of this type of bridge, when the cables are properly protected, is indefinite. There is every reason to believe that the great suspension bridge of to-day will rival in length of service the ancient stone bridges which have stood for centuries.

Employer Representation on the Ontario Workmen's Compensation Board

The Provincial Builders' & Supply Association is co-operating with the Canadian Manufacturers' Association in the latter's effort to have representation on the Workmen's Compensation Board of Ontario. The movement has become intensified as a result of the appointment of a labor man to a position on this board. In this connection, the Provincial Builders' & Supply Association through their secretary, sent the following ing letter to Premier Drury:

Hon. E. C. Drury,
Premier of Ontario.

At the tenth annual convention of the Provincial Builders' & Supply Association, held in Peterborough, on February 21 to 23, the following resolution was adopted: "Moved by Mr. J. S. Webster, seconded by Mr. T. Grace, that this meeting protest against the appoint ment of a labor representative on the Compensation Board, as this means in every sense class representation. We are, therefore, appealing to you to have the same privilege granted to the employers, who are the sole contributors to the compensation funds. Also that the complex of the board be so changed as to admit of this desired representation. We also protest strongly against any proposed increase in the rates of benefits, as we feel that this is an injustice to the investing public and simply adds more expense to the already heavily burdened industry."

Sgd. "Provincial Builders' & Supply Association."

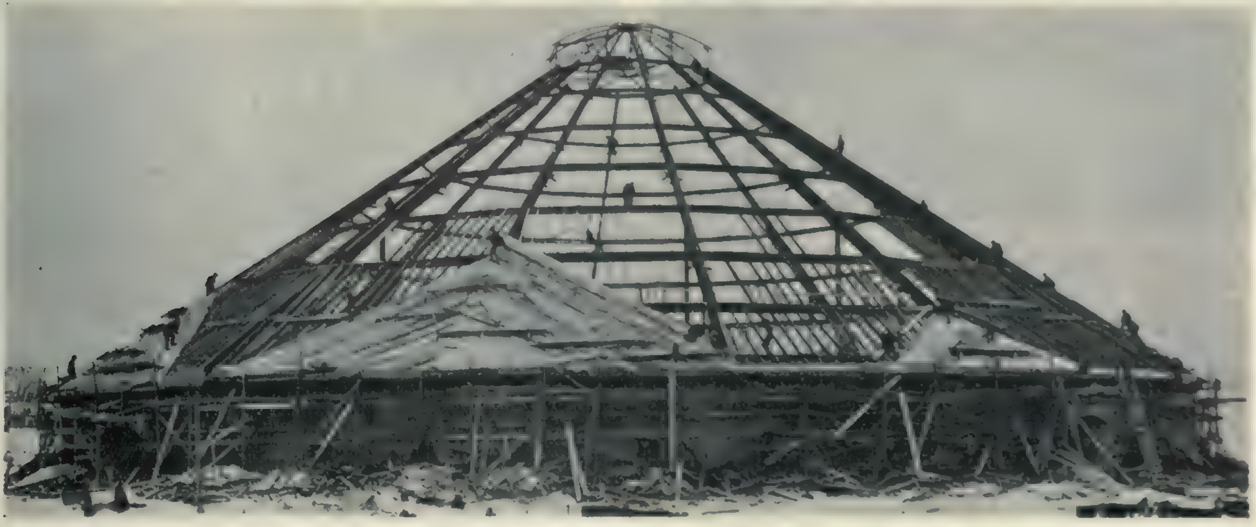
Large Steel Rink of Unusual Design at Moncton, N. B.

Structure is Circular in Plan, 200 ft. in Diameter—Roof Comprising Sixteen Rafters, Each 105 Feet Long, With Purlins and Bracing System, Erected in Twenty Working Days During Winter Weather

By E. HOLGATE, B. Sc.
Chief Engineer, MacKinnon Steel Co., Ltd., Sherbrooke, P. Q.

A rink of exceptional design and large dimensions has recently been completed at Moncton, N. B. The building is circular in plan, 200 feet in diameter, the outside wall being of concrete 17 feet high. Above this is a roof approximately conical, rising to a height of 90 ft. above the ground. The interior is entirely free of obstructing columns and provides a clear ice space of 180 ft. by 90 ft., accommodation for over 3,000 spectators, a cafeteria, retiring rooms and a promenade 600 feet long.

It was first intended by the owners to build the roof of reinforced concrete but ultimately a structural steel frame with wooden cover was adopted as being more speedily constructed and involving much lighter dead loads. This design also reduced the risk from faulty materials placed under adverse weather conditions and from inaccuracies of forms.



Steel work for this rink of exceptional design was very speedily erected

Design of Roof

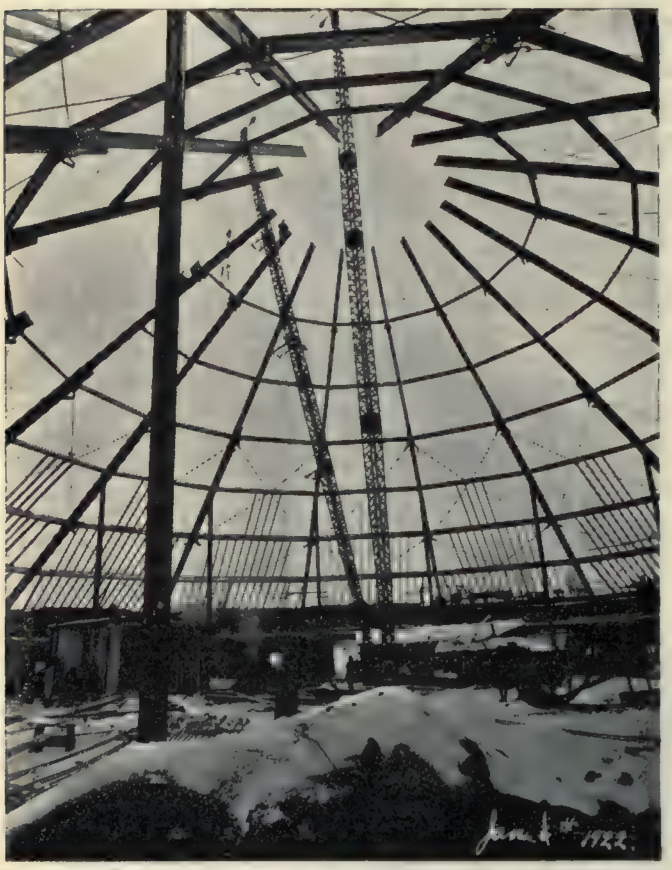
The structural steel consists primarily of sixteen rafters, each 105 feet long, shipped in two lengths, lower and upper. The extreme lower ends rest on steel columns. At the eave of the roof a continuous tie plate takes the tension stress and it is made in 16 straight sections each approximately 40 feet long. The wooden roof joists rest on the wall at one end and on seven rows of steel purlins above. The tops of the rafters stop fifteen feet from the vertical axis of the building, thus providing an opening 30 feet in diameter on which stands a cupola admitting light and ventilation. The purlins are designed for both the bending and compression incidental to this type of construction. To provide for irregular distribution of live loads a system of radial bracing is attached to the main rafters at a height of 50 feet and the upper ends of the rafters are connected by sixteen radial struts. Lateral stresses are brought down to the tie plate by adjustable rod bracing in the planes of the rafters and the tie plate is well anchored to the wall all the way around the building. The roof is of one inch plank, tongued and grooved, covered with roofing felt and nailed to 2 in. by 8 in. joists about 15 feet long. The planks are laid diagonally, alternating in direction on each of the sixteen planes of the roof.

Erection of Steel

The erection of the roof steel was accomplished in twenty working days of wintry weather. It involved some interesting expedients. First a guy derrick was set up four feet from the central vertical axis. This derrick had a mast 112 feet high and a boom 106 feet long and it could lift 6 tons at radius of 101 feet, thus controlling the whole area of the building.

The main tie plate was erected by resting the ends of the sections on the wall, setting them to a pencil line scribed thereon, at a uniform distance from the geometrical axis. The closing section of tie plate therefore slipped straight into place without any time being lost in correcting inaccuracies of radii. The plate was then carefully levelled by wooden wedges.

Next the lower section of the first rafter, 62 feet long and weighing 4 tons, was hoisted into place and held suspended by the derrick whilst its lower end was attached to the tie plate and a temporary wooden post, 10 in. by 10 in., forty feet long, was placed underneath by means of a rope pulled over the niggerhead of the hoisting engine and passing through a block near the end of the derrick boom. A transit over the building axis aligned the rafter in a true radial vertical plane whilst a level was set to a line on the wooden post at a known distance from the point where it touched the bottom flange of the rafter. The latter point was fixed by a lug rivetted to the beam at a carefully measured distance from the tie plate. Wooden wedges under the wood post enabled it to be exactly adjusted in height. After guying the end of the first rafter, the second was erected similarly, and the connecting purlins followed.

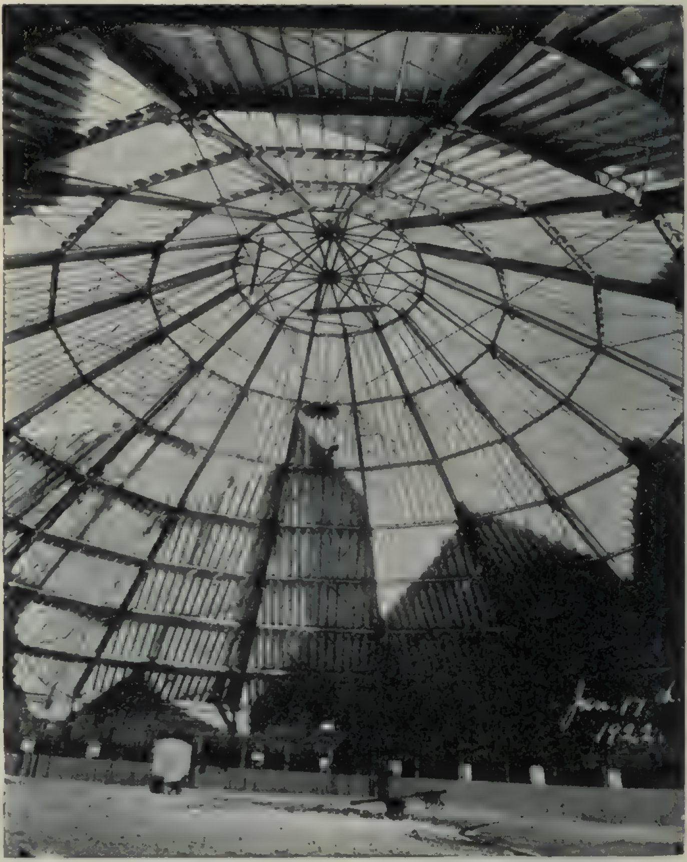


A guy derrick with a 112 ft. mast and 106 ft. boom was used to erect the steel

When the sixteenth rafter was placed it was found that the precaution taken to ensure the easy assembling of the closing sections of the purlins was successful. This was done by setting the wooden posts so that their tops were ¾ in. higher than calculated, thus making the diameter about 1 in. too much and the circumference about 3 in. too much. The closing purlins were held up by long bolts, completing the lower cone of sixteen rafters and four rows of purlins. The wedges under the wooden posts were then slackened until each post was lowered ¾ in. to correct geometrical level. By the time the last post was adjusted it was found that the gaps in the four purlins of the closing panel had disappeared and that the weight of the roof had entirely left the temporary wooden posts.

The latter, however, were not removed because they had another duty when erecting the upper rafters. The erection of these proceeded along with the three upper rows of purlins by cantilevering them from the upper ends of the lower rafters. Although the top ends of the upper rafters were 60 feet from the wooden posts, the weight of the lower tie plates and columns was more than sufficient to counterbalance them. Hence, the lower cone was still supporting itself with its stresses unaffected by the erection of the roof above it. The upper cone was closed by the three purlins of the last panel being powerfully forced into position by derrick and blocks, a procedure which simultaneously corrected the slight deflections contingent upon the cantilevering of the rafters and released all weight from the wooden posts below. To facilitate this operation, the upper bracing was not inserted until after closure was made.

Finally the cupola trusses were placed, derrick dismantled, and then the radial rods and top struts were erected by rope blocks. After tightening all lateral bracing and riveting all purlin connections, rafter splices and tie plate splices, the wooden posts were removed.



The roof comprises sixteen rafters, each 105 ft. long, resting on steel columns and meeting in a cupola

The steelwork amounting to 200 tons for this building was designed, fabricated and erected by the MacKinnon Steel Co. Limited, Sherbrooke, Que. The contract was awarded on November 3, 1921 and the erection was completed on January 16, 1922. The Moncton Supply Co. Ltd., of Moncton, N. B., were the general contractors.

A new bridge is in course of construction over the St. Francis River in the town of Drummondville, P. Q. Its length is 421 feet and it has a width of 18 feet clear. The floor is of concrete. The contract for the structural steel was awarded to the Dominion Bridge Co., Montreal, at $34,200. The balance of the work, such as the raising of piers, abutments, etc., is being done by day work under the supervision of the town engineer, Honore Girouard, B. Sc. A., at an approximate cost of $50,000.

Should Contractors and Mechanics Have Agreements?

The Author of this Article is of the Opinion that Labor Agreements Have Not Been of Practical Benefit, but Have Served to Restrict Operations

By GEO. S. GOULD
Contractor, London, Ont.
Before Provincial Builders and Supply Association

The experiences of the various trade groups in our community have been somewhat varied, but almost universally unsatisfactory. The Master Masons' Association, we believe, have been the most successful in negotiating agreements, with their local union employees, that have embraced certain conditions insisted on by the Employers' Association, and that have been allowed by the International officers. This we believe was only made possible by the International being fortunate enough to possess an officer who endeavored to deal justly with both parties. But even under these favorable conditions they found that it was impossible to impose penalties for any violations of some of its clauses.

The carpenter contractors have at different times, at the solicitation of the carpenters' unions' signed up an agreement with them for supposedly mutual benefit, but there has yet to be a first one inaugurated that has produced any of the promised results; rather they have been the medium of producing discord and distrust.

Master plasterers, too, have had very disappointing experiences along that line. Agreements have been prepared by committees from both parties, every clause of which has been duly considered and agreed upon by each, and finally ratified by their associations, and signed by the arbitration committee of each. Agreements have been made and broken at will by members of the local union, who claim that the International constitution disallows portions of the agreement.

Painters, sanitary and heating engineers, sheet metal workers, and mill men all have suffered like treatment in their experiences of signed agreements with their men.

Don't Miss Signed Agreements

Failure to have a signed agreement with their employees by these different contractors has not in any case, so far, had a deterring effect upon the building industry in this locality, for, with the exception of the master masons' association, that has a signed agreement with the men expiring December 31, 1922, all other trades are carrying on without either a signed or word-of-mouth agreement, in spite of the fact that all wages (in London) were reduced from ten to fifteen per cent. the first of this month.

Regarding working conditions here, the Builders' Exchange, to ensure uniformity of action by the individual members of each section, supervises the wage scale for each trade, and also the hours of work. Other conditions, such as open or closed shops, are regulated by the conditions of the labor market. The master masons and the master plasterers are closed shop here, but not from choice by any means, simply because organized labor has secured control of all the available mechanics in those trades in the local market. All the other trades are open shop, and no inquiries are made as to whether a workman seeking a job carries a card or not.

No Practical Benefit

From these observations of different experiences here we fail to see where labor agreements have ever been of practical benefit to our contractors in the carrying on of their callings, but have rather served to restrict their operations by being tied up by a lot of restrictive clauses included in all agreements. If we grant this to be an established fact, it is not time for us to consider the advisability of discontinuing all negotiations with united labor (or the principle of collective bargaining) and not allow them any choice regarding the manner in which we propose to conduct our business or manage our affairs?

This action would naturally precipitate a crisis and determined resistance on the part of the unions to losing their hold on employers of the building industry. Contractors have been their prey for so long that we may expect them to put forth every effort to defeat us, and for a coming conflict we will need to make careful preparation.

Work in Unison

As far as possible every reputable contractor should be lined up in associations having as their object perfect unison in dealing with the labor question. All local organizations should be subordinate to the Provincial and Canadian associations, who should formulate a plan of action that would govern the action to be taken by every contractor in the building industry in the province or Dominion.

The executive of these associations are in a position to make proper representations to the federal and provincial governments setting forth in a concise manner the cause of our proposed action, making them understand clearly that as employers we are not seeking personal benefits in our endeavors to secure greater freedom of action, but community bnefits. For the fewer the restrictions organized labor is permited to impose upon the building industry, that compel contractors to take these restrictive conditions into account when pricing a job, the less the cost of such a job would be without interfering with the wage end of it.

Public works departments and municipal boards should also be advised to bar any contract conditions in their agreements with contractors, that would restrict the contractor from working what hours he desires, employing whom he likes of unimported labor, and paying the prevailing rate of wage of either his home city or the nearest city to the place where the work is being carrid on.

Proceed With Caution

Pending the adoption of a national or province-wide code of practice to govern the action of local associations in regard to agreements with unions, and as some of the trade associations may consider it to the advantage of their industry in that district to have a signed agreement with their employees, great care should be taken to keep the agreement free from all restrictions. Clauses permitting any interference with the apprenticeship problems, or the demand for a minimum rate of wage, or for double time on Saturday afternoons or holidays, or of the stopping of work on any job until the matters in dispute have been considered by an independent board of arbitration as a court of last resort, or of interference with the employers' attitude in regard to foremen having charge of work should never be allowed, and all agreements made should expire the 31st day of December of each year and subject to be cancelled at any time subject to 90 days' notice.

The basis of all agreements between capital and labor is founded upon the desire of each party to procure more profitable returns from their activities and to expend less energy in so doing.

The development of all such attempts must result disastrously for the continuence of the industry affected, for in their working out in actual practice they beget in the workman less efficiency, as he reasons it out that he has no need to worry, for his reduced output does not affect his boss anyway, but the other fellow has to pay, and as he is protected by an agreement, with a strong union at his back, he can afford to be careless as to the quality of the workmanship he produces, for the boss mustn't kick.

The Employer, Too

Regarding the employer (collectively speaking) he, too, comes under the spell, and takes on an attitude of indifference and carelessness in many of the most important details essential for a satisfactory completion of the work in hand. This condition is a result of his loss of control to a great extent over the methods he would like to employ to carry on his work, and he has to submit with the best grace he can to seeing his work carried on very unsatisfactorily both as to quality and cost.

Freedom of action must prevail amongst all contractors in the building industry, to permit those who would invest their money in buildings to get the best values for their investments.

We would therefore recommend that the executives of the provincial and Canadian associations be requested to prepare propaganda for circulation amongst all employers in the building industry clearly setting forth the injurious effects that agreements between capital and labor that are hampered by restrictive conditions must produce to all interested in building construction.

Everybody Suffers

The general public suffers through an increased cost and inferior workmanship.

The employer suffers through loss of his independence and consequently his self-respect and ambition.

The employees, by being brought to the level of a mere machine, and restricted from developing greater proficiency as well as efficiency in his craft, and the craft itself suffers through a lack of interest amongst the operatives and by a curtailing of the number of apprentices allowed to learn the trade.

Following the putting in circulation of educational matter concerning tradé agreements other steps should be taken by our executives to keep this question prominently before contractors so that before another year dawns definite conclusions may have been arrived at by a big majority of employers concerning the entire discontinuence of labor agreements.

Drydock at Esquimalt, B. C.

A Great Deal of Rock Has Been Taken Out of the Excavation for the Inner Portion of the Dock

By our Victoria, B. C., Correspondent.

On the Dominion government's 1100 ft. dry-dock at Esquimalt, B. C., work is at present proceeding in due course. A great deal of rock has been taken out of the excavation for the inner portion of the dock, which is protected by a pile and earth cofferdam.

A good deal of rock has also been taken out above water for the formation of the level bench for dock side tracks and shops. Steam shovels are in use in the excavations, loading into large skips which are handled by very large stiff-leg derricks and discharged into cars outside the excavation. About two hundred men are being employed at present.

In view of the rumored possibility of a shut-down of this work, upon which several hundred thousand dollars have already been spent, the Victoria Chamber of Commerce and other organizations have been making very strong representations to Ottawa, pointing out the need for the dock at this point, being the first port of call for all steamers bound for either Vancouver or the Puget Sound ports. The geographical situation is considered to be ideal in this respect, and a good deal of repair business is expected to be handled at Esquimalt on the completion of the dock, which now perforce goes to American concerns. The naval consideration is expected to have weight also, Esquimalt being a famous naval station of the old Imperial days, and the logical point from which future naval operations in the North Pacific would be conducted, whether by the Imperial or Canadian authorities.

Deep excavation in progress on the Esquimalt drydock. The bottom of the pit is about 30 ft. below the high water mark

Ontario Road Superintendents Discuss Practical Problems

For the Eighth Time County and Township Highway Officials Gather, Under the Auspices of the Provincial Highways Department, to Exchange Ideas and Benefit by Round-Table Discussion of Their Difficulties

The county road superintendents and engineers of Ontario met in annual session at the Parliament Buildings, Toronto, on February 27 and 28. Mr. W. A. McLean, Deputy Minister of Highways, occupied the chair and opened the proceedings with a few words of welcome to the visiting road officials, expressing his gratification at the large number of delegates present for the opening session.

Mr. George McCubbin, county engineer of Lambton, was the first speaker, his address dealing with the subject of "Road Drainage" from a legal standpoint. He discussed the rights and obligations of the county road departments, as owners of the roads, under the various drainage acts, and enlightened his hearers on many little knotty problems that confront road officials from time to time, relative to the drainage of surface water onto adjoining lands, the damming and bridging of watercourses through the roads and several other points of "common law" with which the average road engineer or superintendent is not familiar. The speaker also outlined the procedure to be followed in the promotion of a drainage scheme, a point which was also very thoroughly discussed by Mr. U. W. Christie, engineer of Dufferin county, who opened the discussion on this subject. This speaker dealt step by step with the method of procedure in the securing of government approval for drainage schemes and the course to be followed in litigation matters. Mr. J. G. Cameron, county engineer of Dundas, Stormont and Glengarry, who also took part in this discussion, urged thorough investigation of local conditions where drainage schemes were proposed and suggested the preparation of a map incorporating the details of design of such a scheme and the local conditions bearing on it.

Beautifying the Highways

The second item on the program of the opening session was an interesting illustrated address, by Mr. H. J. Moore, Forester of the Department of Highways, on the subject "The Beautifying of Our Highways". This address dealt largely with the planting of trees along the provincial highways and the beautifying of bridge structures by the planting of shrubs, the illustrations shown including several beautifully colored plates, depicting some of the results obtained by the department in their work of beautifying the highways to date. Mr. Moore went into detail regarding the proper method of removing small trees and replanting on the highways, the correct location, proper care of the trees, etc., and surprised his hearers by the low figures quoted for the cost of carrying on this work. The expenses of the department last year were but $33,000, covering the purchase, planting, care, etc., of thousands of trees and shrubs on the highways, and the maintaining of thousands of others. Several slides showed the correct method of pruning trees in the fall and of removing limbs, and several others showed the wonderful changes that had been wrought at several road intersections by the planting of flower beds and shrubs at these points. Mr. Moore's department will prepare suggestive plans for the beautifying of spots on the provincial highways, at the request of the residents living along the highways. Other views showed beautiful homes that had been built recently on improved highways. Mr. Moore's talk was a thoroughly interesting and enjoyable one and brought home to his listeners a point too often overlooked by the engineer in his plans for good roads.

The afternoon session started off with a paper by Mr. W. J. Moore, county engineer of Renfrew, on "Concrete Bridges & Culverts", which is reprinted elsewhere in this issue. Mr. Connor, of the Wellington County road department, opened the discussion following the reading of Mr. Moore's paper. He illustrated his remarks with a number of interesting slides showing the different types of bridges constructed by his department. This county has 165 bridges in all, 151 of which are of concrete and 14 of steel construction. The speaker dealt briefly with the adaptability of the respective designs of several of the bridges to their particular location, and outlined the general construction methods employed and the details of design in the case of the larger and more important structures. Illustrations were also shown of a few old bridges of the smaller type which had failed, due chiefly to improper foundation work or conditions. These slides were very instructive and illustrated clearly the necessity for proper care in the matter of foundation work.

Mr. W. J. Kean, engineer of Ontario County, the next speaker on this subject, very concisely summarized the details entering into the construction of a bridge, from the careful selection of the site, onward. Mr. Kean said, in part: "There are three items to be taken into consideration in the erection of a bridge: economy, service and appearance, and appearance is not the least of these, for the extra expense incurred in the selection of concrete in some cases is forgotten sooner than the unsightly appearance of a cheaper type would be........" He, too, emphasized the importance of proper foundation conditions, to be determined by test borings, soundings, etc. He ventured to state that 90 per cent of the bridge failures could be attributed to poor foundations. Another point he spoke on at some length was the importance of clean aggregate for the concrete, the utilization of clean water in the mixture and the proper amount of water to obtain not too thin a mix. Too much water would result in a poor quality of concrete and weaken the structure greatly. In the case of the selection of steel reinforcing, too, every care should be taken to see that a good quality of steel, free from rust, was used, this steel in concrete having just as important a function, he claimed, as the steel in an all-steel structure.

"Roads are an Investment"

Hon. F. C. Biggs, Minister of Public Works and Highways, was the next speaker. He said, in part: "We are glad to see the road superintendents of Ontario assembled once more in Toronto. The past year in Ontario, undoubtedly, has not been the year of least performance in road construction. A great work is being carried on by the province, its counties and townships and the reports of our engineers who have had occasion to visit the location of your work are good." He mentioned particularly the rapid strides being made by the townships in the development of roads, which type of road, two or three years ago, was an unknown quantity, except to the taxpayer. In describing the fast growing interest of the people in good roads, Mr. Biggs said: "The first reason is, perhaps, a selfish one; many people are buying cars and want good roads to drive on, but the great thinking population are getting past the period of criticism and are asking themselves if it does not pay in the saving of time, in making it possible to get their product to the market at the proper marketable time. The people of to-day are beginning to travel more, and the more they travel, the more they see and the more they study the situation, with the result that they are beginning to realize that roads are an investment, not an expenditure."

A Fair Balance on the Question of Wages

Road superintendents, at the present time, he stated, have an important function to carry out. Prices for materials are still high in many lines, while the taxpayer in the country is not receiving value for his products. The unemployment situation extends to rural and urban districts. These conditions, he pointed out, have resulted in the cutting down of the farmer's hiring and buying power. "It rests in your hands to strike a fair balance on the question of wages for labor and the work done. The time is not ripe to jump back to pre-war wages and conditions." We must try to keep the amount of work done within the proper bounds of the taxpaying power of the people, he said, and above all, look to the permanency of the roads built.

The great factor in road construction, a fact which is becoming more and more apparent, is the matter of proper drainage, he continued. He pointed out that if good drainage is necessary for the better class of roads, that is all the more argument why the gravel road should be properly drained. There are many miles of this type of road in the province that will serve twelve months in the year, if the subgrade is properly drained, he stated.

Mr. Biggs next took up the matter of expenditure on highways and said he wished to correct an erroneous impression that the province was spending all the road allowance on provincial highways. On the contrary, the expenditure on county roads has greatly exceeded that spent on provincial highways. For this reason, he proposed the re-classification of roads into classes "A," "B," and "C," the first applying to provincial highways, the second to provincial county roads, and the latter to the suburban or township roads, and in this way avoid the confusing of the first two classes of highway. Road building in Ontario is, from point of expenditure, the second largest undertaking going forward in the province at the present time, exceeded only by the great hydro development.

Importance of Maintenance

Mr. Biggs emphasized the importance of a well defined road maintenance policy, saying in this regard; "The dollar spent on road maintenance is a well spent dollar. When you build roads and get them to a certain state of perfection, keep them there." The new practice of building half-width surfaced roads, with provision for widening, was considered by the speaker an admirable one when carried out in districts where such a width of highway is sufficient to serve the present needs, it being possible to extend the money available over twice the mileage. In his closing remarks, the Minister assured the delegates of his department's desire to co-operate and help the counties in every way possible.

No Roads Neglected

Mr. McLean, following Mr. Biggs' address, stated that he was proud of the road system in Ontario, proud of what had been accomplished by the different road departments. In answering the criticisers of Ontario's road system, who held up the state roads of the United States as an ideal, he stated that the practice in that country is to build permanent main highways, but the secondary roads are neglected, while Ontario's efforts are extended to all classes of highway in every part of the province. "We started at the other end," said Mr. McLean, "and to-day Ontario has over half the total mileage of her roads surfaced in some manner....This condition is due to the highway organizations we have created. I am proud of the roads in Ontario and the time is not far away when criticism of these roads will be unheard of."

Two papers were on the program for the morning session on the second day of the convention, namely "Concrete Road Surfaces" by F. A. Pardo, Kent County road superintendent, and "Gravel and Stone Maintenance" by Frank Pineo, road superintendent of Elgin County. The former paper, which will be reprinted in an early issue, occasioned considerable discussion, which was led by Mr. L. S. Lichty, road superintendent of Waterloo County. This county, according to Mr. Lichty, has had considerable experience in concrete road building, five miles of this type having been constructed last year. In the year previous, a mile and a half of 16 ft. concrete road was laid and it was found that it cracked in the centre, even though drainage was carefully attended to. In order to seek a means of overcoming this defect, a 400 ft. strip was laid with a centre longitudinal joint. This was found to produce the desired effect and this strip developed no cracks. As a result of this experiment, all of the road laid in 1921 was made with the centre joint.

Mr. Lichty stated that all joints should have a seal coat before the close of the season, so that moisture may be kept out. It was his opinion that in the construction of concrete roads, small mixers make better progress than large mixers. This effect had been discovered when the contractors undertook to lay the pavement with a centre joint, the large mixers being too cumbersome for the single 8 ft. strip. Importance was also attached to mid-season concreting, as it was deemed unwise to prolong operations into the end of the season, when weather conditions retard the setting of the concrete.

Mr. Brien, city engineer of Windsor, related his experiences with concrete roads, of which his city had a million and a quarter yards. Reinforcing in his opinion minimized cracking and tarring was an effective agent that should be used on every crack. The use of concrete roads as foundations for asphalt surfacing, when the concrete has lost its usefulness, was advocated by Mr. Breen, who believed that there was an economic limit in the thickness to which concrete should be carried.

Mr. Rutherford emphasized the importance of the water content in concrete mixtures for road work and, in reply to a question, stated hat crushed stone was preferable to gravel as an aggregate. These opinions were confirmed by other superintendents present.

The discussion on Mr. Pineo's paper was led by Mr. R. H. Fair, Frontenac County road superintendent, and Mr. S. Fox, Hastings County road superintendent, each of whom gave his opinions on gravel and stone roads, the importance of which was generally acknowledged.

Bituminous Treatments.

The afternoon session on the last day of the convention started off with the reading of a paper on "Bituminous Road Surfaces", by Mr. Alan K. Hay, engineer of the Ottawa Suburban Road Commission, which is also published elsewhere in this issue. Mr. G. Marston, county engineer of Norfolk, which county has built a considerable mileage of roads of this type, opened the discussion which followed the reading of the above paper. Mr. Marston said that his county, in adopting this type of road in 1917, designated 230 miles of road to be bituminous surfaced, a policy that is being followed out each year. Mr. Marston touching on the matter of economy in road building, thought that economy might be practised in many other ways. He quoted figures showing the amount of money invested in automobiles and trucks in his county, the total mileage of which, figured on the conservative estimate of 10 cents per mile as the cost of operation, resulted in a figure out of all proportion to the amount expended to build and maintain roads to run these cars on. This item of car operating expense would be cut down by easier travelled roads. One automobile dealer in his county, Mr. Marston stated, had contracted for about $200,000 worth of one make of car to be sold this year, a figure which equalled 15 mills on the assessment, yet 6½ mills was all that was available for road construction.

Mr. Marston was emphatic on the necessity of using a uniform 2-in. clean stone in the bituminous-type road, and to this end suggested the placing of an inspector at the quarry to see that the municipalities are supplied with a first-class uniform 2-in. stone. He went on to explain the quality of subgrade in his county, which made it necessary to get away from standard base specifications. Sub-grade is composed partly of gravel and partly of sand, it being necessary when laying a road base in the sandy spots to put in sufficicient stone to bring the foundation up to elevation.

He estimated that this type of road had cost, on the strip constructed between Simcoe and Port Dover, approximately $23,000 a mile, including grading, culverts and ditches, and was satisfied that it had justified its construction. He said that his experience had been that coarse sand was superior to the pea gravel, for use with the Tarvia maintenance treatments. He advocated promptness in the heating of tar, stating that much time could be saved and the cost of railway demurrage eliminated if arrangements are made to have the tar heated immediately upon arrival.

Mr. Wm. Watters, county road superintendent of Lanark, which county has also built bituminous roads, of both the tar and asphalt penetration types, stated that he had had excellent results from the use of both the tar and the asphalt penetration methods and could not state a preference for either. He had used the same machine for the distribution of both. It was the general opinion of the conference that the important factor in the bituminous-type road is a uniform, good-quality 2-in. stone. Mr. Alan K. Hay suggested the purchase of storage tanks by counties contemplating the construction of roads of the tar penetration type, in order to dispense with the item of railway demurrage. Another opinion that received the unanimous endorsation of the discussers was that the only way to get results from a gravel road, treated with a bituminous surface, is to treat it yearly, or as often as is necessary, with a Tarvia surface coat.

Hard Surfaced Roads on Grades.

Mr. Muir, one of the Departments engineers, who occupied the chair throughout this day's sessions, in dealing with the question of danger to horse-drawn vehicles on hard-surfaced roads in the winter time, on grades of 5 per cent. or more, stated that this type of road must necessarily be more or less slippery at certain times of the year, in spite of certain treatments suggested by various members, but he pointed out that any type of road is slippery in the winter time and he thought the solution of the difficulty, as far as the horse-drawn vehicle was concerned, lay in the design of the horse's shoes. Many members recited instances where hard-surfaced roads had existed for some time on various grades from 5 to 11 per cent., no difficulty having been reported on these grades.

Mr. McLean, while favoring the use of the open type of drain along roads in flat country, was of the opinion that, as a factor of safety, the sewer pipe or enclosed drain should be laid along roads where there is a grade. The advisability of doing away with trees along the highways, suggested by one of the members, who was of the opinion that roads were constructed first from the viewpoint of utility, and thought the difficulty caused by the leaves falling in the ditches and the roots interfering with the tile drains, should be eliminated by the removal of the trees. was strongly objected to by many members. Mr. Pineo thought that tar paper around the tile would prevent the entering of roots and was confident that the careful planting of trees, at intervals of 50 or 60 ft. would not constitute a serious menace to the highways. He felt sure that their few evils were offset by their many advantages. Mr. McLean also spoke a few words in defense of the trees. He pointed out their advantage in preventing the drifting of snow on the highways.

Placing of Stone in Winter Time.

Mr. Talbot took objection to the statute which forbade the placing of road metal on the roads in the winter time and was supported by several members in his view on this ruling, one member pointing out that this statute was unnecessary, because if gravel was piled carelessly in big piles on the highways, occasioning an accident, the person responsible for this placing of material would surely be punishable outside the statute. He did not see why the careful application of road metal in the winter time should be considered wrong by law. It was suggested that winter was the right time for the application of gravel, winter travel being sufficient to iron this out sufficiently in preparation for the heavier spring traffic.

Early Preparation of Road Programmes.

The last paper on the program, "The Early Preparation of County Road Programmes" was then read by Mr. Frank N. Rutherford, county engineer of Lincoln. The speaker, following the reading of his paper, referred to the difficulty of the county road superintendent going ahead with the preparation of a road policy which might not meet with the approval of the new county council. He thought that the planning of a county's road system should be under the jurisdiction of one man, with power to carry out his policy.

Mr. E. L. Miles, county engineer of Victoria County, opened the discussion on this paper. During the course of his remarks, he suggested the organization of some sort of a tour, during the summer months, so that engineers and road men in one part of the country would see how the other fellow does his work. He also referred to the difficulty experienced in satisfying the people in all parts of the county, which made it practically impossible to start a road in one district and go ahead with it to completion.

Mr. McLean said in this connection: "I have always found that the most successful county is the one where the county road superintendent seeks to help and guide the council, instead of where the council is left to plan the road program. A county road system should be planned from year to year. The superintendent should formulate a scheme for a certain period and if he puts his well-laid plans before his council. I think the council, through a process of education, will fall in with his plans. You will be able to say: "We are going ahead with this road this year and we will do that work next year". Your difficulties will lessen as your road system begins to connect up and the people begin to see that you include their district in your plans."

Mr. N. L. Powell, county engineer of Peel, also took part in this discussion and recited the difficulties of his department in linking up the various sections of the county by good roads. There is a ruling in his county which states that money raised in one township must be spent on roads in that township.

Mr. McLean introduced Prof. Lang, of the University of Toronto, to the meeting, who, in a brief address, assured the members that the services of his department to assist them in any way possible, were at all times at their disposal.

The suggestion of Mr. Miles that a tour be organized by the road officials in different parts of the province, to visit the "other fellow" on the job, was taken up by Mr. Aylesworth, who further suggested the appointment of a committee to organize this tour. The idea, however, did not meet with universal approval, due to the expense that would be incurred, in the first place, and the scarceness of time during the busy summer road building season.

It was decided by the meeting to extend the convention to another private session for a general discussion of matters of interest to the members, it being felt by some present that the two-day conference had not been long enough for a thorough discussion of business matters. The success of the convention may be attributed jointly to the large number of interested road superintendents and engineers present at all the sessions, and to the hearty co-operation and supervision of the officials of the Highways Department, including, Messrs. W. A. McLean, R. Muir, G. C. Parker and others.

Maintenance of Gravel and Stone Roads

Practical Ideas on the Repair of an Important Type of Highway—Methods Used in Elgin Co., Ont.

By Frank Pineo, Road Superintendent, Elgin County, Ont.

The maintenance of a roadway is the keeping of it as nearly as practicable in the same condition as it was when originally made; the repair of a roadway is the work rendered necessary to bring it up to its original condition after it has become deteriorated by neglect to maintain it. Thus there is a wide distinction between the two operations, and when the comparison of costs is instituted, errors are frequently caused by setting the repairs of one road against the maintenance of another or vice versa.

No matter how well made a structure may be, or how carefully the materials used have been inspected, the use of it will exhibit defects which it is almost impossible to guard against, such as variableness in the quality of the material and slighting on the part of the workmen. Moreover, every material, whether natural or artificial, is continually undergoing a process of deterioration by the action of the elements; this decay is hastened or retarded in proportion to the means employed and care bestowed to arrest it.

The crown of the road should be sufficient to allow water to pass freely to the ditches on the side of the roadways. On many of our gravel roads in Elgin County, the shoulders were higher than the centre of the road. These have been thrown outward and either spread uniformly along the sides or drawn to some narrow or dangerous point on the road. Where the shoulders of the road are high, it makes impracticable the use of the most necessary implement for the maintenance of a gravel or earth road, the split log drag. After the shoulders have been thrown outward, the grader is then reversed and if there is any good material, it may be drawn to the centre of the road. Great care should be taken that no sods or poor, worn material is thrown into the centre of an old gravel road. Resurfacing should be done with nothing but the best grade of screened gravel, well spread out, free from earth or any stones that will not pass through 1¾ inch ring.

In Elgin we have two hundred and fifty six miles of county road; of this mileage about one hundred and ninety miles, is gravelled. Twenty five is either macadam or stone road, and the balance is clay or sand. We own five gravel pits, these being located in different parts of the county with a view to trying, as near as possible, to furnish material for the entire county highways and not have the haul exceed more than ten or twelve miles.

A semi-portable bin, elevators and screen are used for handling the gravel. The bin holds thirty tons; the floor or bottom has a slope of about fifty degrees, so that the gravel will slide to the opening or chutes on the side of the bin. The gravel screen is nine feet long, all in one piece with three feet perforated with quarter-inch holes for sand, three feet blank to carry gravel across the bin which is twelve feet wide, and three feet of one and three-quarter inch holes. The elevator is of the bucket type thirty-two feet long with hopper at the bottom. Gravel is brought from the bank with the ordinary slush or slip scraper drawn by a horse and dumped into the hopper, the horse passing directly over the hopper which is protected by grizzy bars.

A regular gang of men are employed in this work during working months. They are furnished with portable cook house, sleeping tents, etc., this equipment taking care of the whole gang including the truck drivers. We handle from 125 to 160 tons of gravel per day.

Teamsters usually haul about 1½ yards to the load and the orders given them are to make four dumps of this size load and spread it at least 10 feet wide. In this manner one load of gravel will cover about forty feet of road in length. Our trucks are of the dump body type carrying a load of five yards. This size of load will cover about two hundred feet of road in length, six feet wide; in some cases three widths of gravel are put in by the trucks, making a spread 18 feet wide.

In our county gravel is our natural road building material and while this may not be the best type of road to construct, I believe that we can build enough extra miles of fairly good road to travel on than we would if we were to expend our money in a more permanent road on a small mileage.

The county of Elgin has no road roller, nor do I see any use for one as long as we continue our present line of work of constructing and maintaining gravel roads. A gravel road is very apt to break up during the early spring, but it is only a matter of a few days if properly attended to at the right time, for it to come back to its original shape. An emergency of this kind should be provided for by having storage gravel piled alongside of the road.

Method of Going Over Gravel Roads

I have found that the early spring is the proper time to go over our gravel roads and shape them for the coming summer. Where a gravel road is inclined to be wavey our method for levelling is to use the standard size grader, turn the blade crosswise and plane the unevenness down in this way. This can be done in the early spring. If we find the road bed too hard for the blade we remove it and attach a scarifier on the grader where the blade has been. After the roads have been shaped in this manner the ordinary split log drag will keep them in a fair condition for the balance of the summer, providing that enough shifting material is on the road which is quite necessary in order to maintain a gravel road.

Gravel should never be placed on an old gravel road more than two inches in depth. Never get so much gravel on the road in one place that the traffic will not continue to pass right over it. Use the traffic to roll out your road instead of a road roller. A patrolman should be appointed about every two and one half miles, and he should be furnished with a split log drag or small grader. I am not in favor of too much mileage for one man. Get the right kind of man interested, farmer preferred, who will have a little time after a rain, which is the proper time to scrape the road, and in this manner the whole system can be gone over in a few hours. And if you find a man neglecting his road, get rid of him.

Bituminous Treatments on Macadam

Surface Applications a Necessity to Prevent Deterioration—Types of Treatment and Methods of Applying Them--Equipment for Handling the Material

By ALAN K. HAY
Engineer, Ottawa Suburban Road Commission

The surface treatment of macadam road with some form of bituminous material has now become a necessity to prevent rapid deterioration caused by surface stone being ground into dust or mud under ever-growing traffic. If surface treatments are used with discretion, the life of a road is considerably prolonged and maintenance charges are lowered. A good macadam road treated with tar or oil shortly after its construction and consistently re-treated each succeeding year will render excellent service under a very considerable volume of traffic, more especially, if the bulk of the traffic is carried on rubber tires. However, heavy horse-drawn loads on steel tires are its worst enemy and in the spring of the year such a surface will cut up badly, if subjected to much of this class of traffic. On the other hand, the tires of automobiles and light or medium-sized trucks have the effect of ironing out the surface and do it comparatively little harm.

Surface treatments vary in character from a very sketchy cold application of light oil or tar used as a dust layer to heavy coatings of binder accompanied by a substantial coat of fine crushed stone.

Type of Treatment

The type of treatment for any given road can be decided only by local conditions but in general, the most successful type of surface will be one falling midway between the limits above. Partially worn out roads with surfaces showing only a small amount of exposed stone may often have their effective life prolonged a few years by an application of one of the lighter liquids without any covering material. The better class of macadam surfaces should have an application of heavier material which has been heated and should then be covered with a thin coat of stone chips, pea gravel or sand.

On this kind of road, the mistake is often made of endeavoring to build up too thick a carpet or blanket on the road in one operation. The result is a surface which looks well and wears well for a few months and which closely resembles an asphaltic concrete or penetration road, but in a short time this blanket of tar or asphalt pushes into waves and humps and if there is much horse-drawn traffic to cut it, will often peel from the road metal in large areas. This unfortunate result may be avoided by applying the bituminous material in smaller quantities, building up a thin skin coat which subsequent light treatments may be applied, gradually forming a tough thin film over the road. On a newly constructed macadam road, a treatment during the first season of one-third of a gallon per square yard, followed by one-fifth to one-fourth gallons in the following years should in most cases be sufficient.

A large quantity of material is now on tne market which is suitable for applying to the road without heating, but usually it will pay to heat even fairly light oils or tar products in order to secure greater penetration into the road surface. The slight additional expense and trouble of heating is more than offset by the better results obtained.

Methods and Appliances

There are two ways of purchasing bituminous material, either in tank-car shipments or in barrels and drums. Tank car shipments are by far the most satisfactory and material should not be bought in barrels, unless the amount of road to be treated is extremely small or railway facilities are wanting.

The average tar or asphalt used for this work may be unloaded from the tank car without heating it, unless the weather is exceptionally cold. Some organizations prefer to heat it in the car by means of a portable boiler connected to the heating coils and then convey it to the road in a distributor which has been insulated in some manner to retain the heat. On my own work, I have found it convenient to unload the material cold and afterwards heat it in the distributor while on the way to the place where it is to be used.

There are several standard methods of unloading. If there is a large amount of road surface to be oiled or tarred each year, and which is concentrated within a fairly compact area of country, it will pay to put in a siding with an elevated trestle, up which the tank car may be run and then unloaded by gravity into storage tanks or distributors.

However, on most work the initial cost of this installation might not be justified, and arrangements must be made to utilize various sidings located as near as possible to the work in hand. In this case a portable pumping outfit is a necessity. There are several excellent pumps on the market designed for the handling of viscous liquids of this nature and if funds are available such a pump would be a good investment. On my own work, we use a make shift outfit which operates quite satisfactorily under average conditions. It consists of an ordinary good plunger hand-pump, commonly known as a tank pump, operated by a one and one-half horse power engine and pump jack. As an auxiliary we use a Tarco hand pump, which is a sheet metal affair closely resembling a bilge pump used on boats. The motor-driven pump is connected to the bottom of the car by a pipe two or three inches in diameter or by a flexible steel hose. The asphalt and tar companies are standardizing their tank cars so that a few standard connections carried in stock will fit most tank cars that are now on the railroads.

Distributors

For the usual amount of work handled by counties, especially when at some distance from the larger centres of population, a horse drawn distributor will prove most economical. Very few counties have a sufficiently concentrated mileage of road to justify the purchase of a large unit mounted on a truck and in addition, the ground in the neighborhood of our usual railway siding is of such a nature as to make it difficult for trucks to approach the tank car, more especially after a shower of rain. A horse-drawn machine of five hundred gallons capacity may be operated economically on hauls up to four miles and for longer hauls may be equipped with a short pole and hauled behind a motor truck. On the suburban roads near Ottawa this year we are contemplating equipping a 15-27 tractor with rubber tires for handling distributors on the longer hauls, when the tractor is not engaged on grading work. For short hauls with moderate grades one team of horses is sufficient but if there are many hills two teams will be required. By using two distributors, lower costs will be obtained. One will be filling at the siding while the other is on the road. The investment required is not large, as the average machine with jets, rotary pumps, kerosene tank and burners, should not cost much over $1,000.00. In purchasing a distributor, an important requirement is that it shall be fitted with an efficient devise for straining the liquid before it passes through the jets. If it is not provided with proper screens or strainers, small particles of sand or carbon will block one or more nozzles and cause exasperating delays on the road.

Sweeping

It seems hardly necessary to say that the road surface should be thoroughly cleaned before oil or tar is applied. A horse-drawn revolving broom is of very great value but should usually be followed by a few men with stable brooms to touch up spots which may have been passed over by the large sweeper. Applying bituminous material on a dusty road almost invariably results in a poor job.

Covering Material

Many specifications call for stone chippings or pea stone as a covering material. If crushed from good hard rock, stone chips make an excellent cover, but if composed of soft limestone the advisability of using them is doubtful, as limestone pulverizes very quickly under traffic. Furthermore, stone chips or screenings are usually not to be had, or when available are urgently needed for other purposes in the road construction.

Pea gravel or coarse sand are the materials most commonly used. Of these I have found gravel superior as it wears better, gives a gritty surface which provides better foot-hold for horses and will not blow away in the first breeze as will much of the sand which is commonly used for this purpose. If screened pea gravel is too expensive, a fine pit-run gravel may be used. It will be necessary to rake the surface of the road to draw the larger stones or pebbles to the shoulder, but this adds very little to the cost of the operation as there are often idle periods for the spreading gang while waiting for the distributor, during which two men with rakes will quickly cover long stretches of road.

(Continued on page 228)

Ontario Good Roads Association Meet for Twentieth Time

Largest Representation in the History of the Organization Convenes in Toronto—Keen Discussion on the Question of Payment for Provincial Highways—Assessment for Benefit to be Thoroughly Investigated

With an attendance exceeding that at any of its past conferences, the Ontario Good Roads Association held its twentieth annual meeting at the Veterinary College, Toronto, on March 1, 2 and 3. The interest and enthusiasm displayed in the proceedings were very keen and the discussions were widely participated in, the result being that some definite action was forthcoming on many important highway matters.

The first day's session was largely introductory, leading up to the more intensive work of the second and third days. After registration the Nominating and Resolutions Committees were appointed. The former comprised the executive, with five members nominated by the meeting. The Resolutions Committee, it was decided, should comprise ten members selected from the Association as a whole, together with the executive. They were then appointed and immediately went into session to consider any resolutions submitted.

The afternoon of the first day was devoted to a number of addresses, the first, by Hon. F. C. Biggs, Minister of Highways for Ontario, reiterating largely his remarks before the Conference of the County Road Superintendents, as given on another page. He again stressed the importance of township roads to the province as a whole, characterizing this class of road as one of the greatest essentials of a road system. A progressive policy with regard to the building of this class of road, he considered, would stimulate interest in good roads in general, and this stimulation was constantly needed, because road work was not advancing too fast in comparison with the great annual increases in the number of motor cars and trucks making use of the highways. Mr. Biggs pointed out the wonderful growth in the interest in roads, as evidenced by the fact that 37 counties were now involved in the provincial aid scheme and that the provincial subsidies to counties on road account had risen from $55,383 in 1903, to $4,750,000 in 1921. In spite of these facts, road development was considered by Mr. Biggs not to be progressing fast enough. In many counties the increase in traffic was wearing out the roads faster than the authorities could repair them but it was thought that the wide extent of the provincial system, taking in every county, would relieve the counties of much of their mileage and enable them to devote more energy to county systems.

In regard to practical construction, Mr. Biggs emphasized the importance of drainage. He also pointed out the possibility of using 9 ft. concrete roads, with shoulders; or a 9 ft. strip on one side of the right-of-way as a means of covering a large mileage until traffic warranted a wider surface.

The Lieutenant-governor of Ontario, Hon. Harry Cockshutt, declared that the road system of the province was being handled in the right way. "Road construction," said his Honor, "is now being definitely pursued on a sound policy. Good roads are one of the greatest assets a Province can have, not only because they save time, but because they reduce the wear and tear on horses and wagons and on automobiles which use the roads."

The soundness of Ontario's road policy in allowing the foundations of main highways to set before permanent surfacing was undertaken was commented upon by Mr. Prevost Hubbard, representing the Asphalt Association. Many of the failures of road surfaces in his country, he considered, were due to lack of this policy. It might have the fault of making the people impatient at the long period elapsing before the final finishing of a road, but it was the soundest and most economical procedure, he thought, and one which was agreed to by the great majority of the people. The policy was the best, he said, because it gave plenty of opportunity to the road engineers to hunt out the hidden faults in the sub-grades.

Mr. Hubbard's address described the development of the higher types of pavements—asphalt, brick and granite. The use of asphalt surfacing over old macadam was also pointed out as proving serviceable.

The address of the president of the Ontario Good Roads Association, Mr. T. J. Mahoney, outlined the progress of road legislation in Ontario, linking that up with the activties of the Association. He characterized the present highway policy as well-balanced, since it made adequate provision for all kinds of traffic and developed the roads according to the needs.

Traffic Regulation

The morning session on Thursday started off with a discussion on Traffic Regulation, this subject being subdivided into three sections, "Lights on Vehicles", by John Currie, ex-Warden of Middlesex; "Speed", by W. G. Robertson, of the Ontario Motor League, and "Headlights", by G. C. Parker, of the Department of Highways of Ontario. The first speaker reviewed the developments along the lines of enacting legislation enforcing the use of lights on vehicles, declaring that Ontario has been backward-in the enforcement of this measure of safety. He referred to the advancement that had been made along this line at other points on the continent. Practically every country in Europe has made provision for this safety measure; even backward Russia has a law to this effect.

Mr. W. G. Robertson in dealing with the subject of regulating speed of vehicles on highways told of the results obtained from a number of tests carried out by the Ontario Motor League to determine the impact of trucks on certain types of highways, when equipped with pneumatic and solid tires and driven at a given rate of speed. He brought out the point that the factor of safety has always been the big item in the regulation of speed, and, with all due consideration of the importance of this factor, suggested that a minimum rate of speed be set on heavily travelled highways, to facilitate the movement of transportation.

At this point in the proceedings, the chairman introduced to the meeting Mr. R. Nesbitt, a member of the Toronto Board of Control, who was present to extend the welcome of the city to the visiting road men. He assured the meeting that the city of Toronto has always been keenly interested in the subject of good roads and was fully aware of the good work being done along this line by the Ontario Good Roads Association. He promised, on behalf of the city, full co-operation wherever possible in the development of the good roads movement.

Lights on Vehicles

Mr. G. C. Parker, of the Department of Highways, continued with the third item in the subject of traffic regulation, that of headlights. His remarks dealt largely with the action taken by the Ontario government, first in 1917, to determine upon certain requirements to be observed in the manufacture and use of headlights. A number of tests were undertaken by the Department of Highways in 1920, numerous devices on the market at that time being examined and condemned or commended upon their merits. The lamp was required to illuminate the road to a certain intensity for a distance from 75 to 100 ft. in front of the car, to a height of 42 in., or parallel with the top of the headlights. He summarized the three requirements necessary to obtain the correct results from headlights as (1) the proper location of the bulb to obtain correct focus; (2) tilting of lamps to confine the volume of light to the 42 in. height prescribed, and, (3) the securing of the maximum candle power lamp. He pointed out the necessity of frequent inspection of headlights to maintain the proper adjustment, lamps being subject to movement from jars, etc.

Highway Accounting

The subject of "Highway Accounting was next dealth with by Mr. Frank Pineo, Road Superintendent of Elgin County, Ont. Mr. Pineo discussed in turn the various forms utilized by his department for the control of its finances and check on stocks. Every detail of expense, revenue and inventory is under systematic control in this well planned system of highway accounts. The system, as described by Mr. Pineo, is thorough and provides the officials with a perfect check on what is being spent, where it is being spent and the country's assets in machinery and supplies, at all times, and requires the services of but one assistant to the superintendent, together with the cooperation of the foremen on the work, to control. Mr. Pineo stated that he felt they were well repaid for the little trouble necessary to organize this system of accounting, by being always in a position to answer with figures the criticisms that are bound to arise with regard to the dispensation of road funds.

Who Should Pay for Provincial Highways

Mr. F. H. Richardson, warden of Ontario County, in a lengthy address, opened the discussion on the next subject, "Provincial Highways—How Should They be Paid For; Would Direct Taxation be Justified; Should There be a Provincial Equalization of Assessment?" In the opinion of the speaker, the present distribution of the cost of constructing the country's highways is a most honest division of the responsibility and he assured the meeting that Ontario county was very well satisfied with present arrangements. He severely criticized large cities for seeking to shirk their financial responsibility in this connection. He felt sure that the present scheme of assessment found favor with nearly every municipality and declared there was no logic in the argument from some quarters that the province should look after the total cost of provincial highways, because it took over these highways, and declared this stand was a subterfuge to avoid responsibility. He felt that if cities were allowed to evade their just duty in this respect, the very fabric of the good roads movement would be destroyed. He touched on the criticism of the quality of roads being built in county districts, stating that it was both impossible and impracticable to construct the same type of roads in these disttricts as are being built in the surburban areas where the demands of traffic call for a more costly and permanent type of road. In concluding his remarks he congratulated Mr. Biggs on his highway policy and stated that a realization of this system could only be brought about by all districts, benefitted by the system, acting fairly and not evading their just apportionment of the expense of the development. He singled out Toronto as an evader and stated if this city could not see their just responsibility, the neighboring county of Ontario, which he represented, would see if they could not have a word in the determining of the city's responsibility. It was decided to postpone the discussion on Mr. Richardson's address until the afternoon session.

Mr. W. A. McLean, Deputy Minister of Highwys, speaking at the afternoon session on March 2, emphasized the importance of township roads and urged the association to give greater consideration to this particular branch of the highway program. In his opinion too much attention was being paid to the provincial highways at the expense of the roads which were of more intimate importance to the farmers. Mr. McLean urged the townships to improve their organizations, so as to better cope with their road problems and also take advantage of the experience of the provincial highways department and co-operate with them to the best possible degree.

"Assessment in Proportion to Benefit" was the topic of the address of Mr. K. W. McKay, county clerk of Elgin, who made a plea for the amendment of the present legislation to admit of the increasing of assessments of property along improved highways in proportion to the benefit that was derived as a result of their location.

Mr. S. L. Squires spoke briefly on highway work in other provinces than Ontario and urged greater co-operation between the provinces in order that the country might be built up in the best manner.

Two short papers on "The Maintenance of Stone and Gravel Roads" completed the session. That on stone roads was by Mr. Stainer, while the other paper was by Mr. D. J. Kean, superintendent of highways, Ontario County.

As time was limited, the discussion on the question of payment for the provincial highways was transferred from the afternoon session to the next day.

Payment for Provincial Roads

On the opening of the last session of the convention on Friday morning, the postponed discussion on the question of whether the Provincial government should assume the full cost of provincial highways was again taken up. Mr. George Clark, of Frontenac County, stated that their assessment on provincial highways would amount to 10 mills on the dollar for the next 15 years, an amount too heavy for the county to bear. It had been estimated, he said, that local traffic constituted but 2 per cent. of the total traffic over the main highway through his county. Mr. Phillips, representing the united counties of Northumberland and Durham, supported the views of Mr. Clark to a certain extent, but his suggestion was that there be a readjustment of the assessment to lighten the financial burden of the smaller municipalities. The next speaker, too, concurred with the viewpoints of the previous speakers, arguing that when the township builds a road of its own, it knows just what expense it can bear and can build according to its means, but in the case of the provincial highways, the township has no say in the amount of money to be spent, has no say in what material should be used in the construction of the road, and he thought that when the government could finance 80 per cent of the cost, they could very well take over the extra 20 per cent which burdened, in many cases, the small municipalities heavily.

Mr. F. L. Mason, of Ontario County, did not agree at all with the stand taken by the previous speakers, and was inclined to think they had looked on the matter in a narrow way. He likened the provincial highway, with its branch roads leading into it, to the railway line with its branch lines, and argued that the rate of travel on the branch lines of the railway was the same as on main lines. "We all want good roads", he said, "but don't want to pay for them." He did not favor the policy of full rebates by counties to municipalities for road construction. He did not consider it fair for the city of Toronto to pay on suburban roads for a distance of ninety miles from the city to the north and only four miles to the east, and thought that this payment should be made on suburban areas for an equal distance in all directions from the city. In general, he thought the present highway policy was a very considerate one.

Mr. Preston, from Frontenac county, in answer to Mr. Mason's remarks, said that the men in western Ontario could not realize the problem of the eastern counties. He stated that road construction in this part of the province is very costly owing to the irregularity of the country and the rocky nature of the soil, and estimated that 50 per cent of the people in Frontenac county, who pay for provincial highways are so situated that they will never be able to use them.

Present Policy Supported

Mr. Ray, of Wentworth County, strongly denounced the attitude of those municipalities and counties that objected to pay on provincial highway construction. "We have asked the government to build these roads and it is now up to us to help pay for them," he said. He thought the present administration was a very fair one and doubted if there would ever be another government generous enough to allow townships a subsidy for township roads.

Mr. Bell, of Carleton County, while supporting the views of Mr. Ray and Mr. Mason, suggested the advisability of devising some method of checking up costs on provincial highway construction, to lighten the burden in instances such as in the case of Frontenac County. He considered, however, that the province had been very fair in their dealings with his particular county and was not criticizing in any way.

The final item on the program, the subject of "Township Roads", was then discussed by the following township superintendents: Messrs. Peter Upcolt, of S. Gosfield; James Todd, of Yarmouth; Walton Smith, of Nepean; James Hunter, of Nelson, and W. E. Hambly, of Townsend. The subject was divided into the following sub-headings, "Maintenance", "Construction", "Township Highway Accounting", and "Statute Labor Commutation or Abolition," each of which aspects was discussed thoroughly by the above speakers as it applied to their respective townships. Some very valuable information on the cost of construction and maintenance of the commoner types of gravel roads being constructed in the townships was given by the various speakers and much interest was taken by the meeting in the subject.

To Study Assessment for Benefit

The report of the Resolutions Committee was then read by the chairman, Mr. K. W. McKay. This report embodied a single resolution, which read as follows: "Resolved, that in the opinion of this convention, a commission should be appointed to consider and report on all matters pertaining to assessment for benefit due to the construction of improved county and provincial highways."

An amendment to this report was moved by Mr. H. Russell, seconded by Mr. Geo. Clark, which read as follows: "That the report of the Committee on Resolutions be amended to read that the government assume the whole responsibility of building and maintenance of all provincial highways and that a vote of the delegates here present be taken on the above question." This amendment was defeated, however, and the original report adopted.

The report of the nominating committee was then read by Mr. L. E. Allen, the following names being submitted for office. Honorary Presidents, L. E. Allen, of Belleville, and T. J. Mahony, of Hamilton; president, W. H. Brown, of Bruce County; first vice-president, John Currie, of Middlesex County; second vice-president, Hon. Geo. S. Henry, of York County Directors: J. E. Jamieson, of Singhampton; F. A. Senecal, of Plantagenet; W. H. Nugent, of Hastings County; Alvin Rose, of Brant County; Peter Ray, of Wentworth County, and F. Richardson, of Ontario County. These names received the unanimous approval of the meeting, the report being adopted on motion of Mr. S. L. Squires, seconded by Mr. W. H. Pugsley. The nominating committee further suggested that a secretary-treasurer be appointed, to devote his whole time to the affairs of the association, it being felt that the organization had attained such size as to require the services of such an official. This matter was left to the consideration of the executive.

The retiring president, Mr. T. J. Mahony, introduced the new president, Mr. W. H. Brown, of Chesley. Mr. Brown thanked the members in a few sincere words for the honor conferred on him. "I feel" he said, "that the best word I can leave with you is that you talk good roads, think good roads and boost good roads."

An invitation was presented the association to hold next year's convention in Hamilton, for which the president thanked the tenderers and which was passed on to the executive for consideration.

Thew Steam Shovel Described

The Thew Shovel Co., Lorain, Ohio, have recently issued Bulletin 111 describing their type 0 steam shovels. The catalogue very completely illustrates and explains the design of every working part of the machine. The adaptability of this type of shovel is indicated while a table gives its working range under various conditions.

Concrete Bridges and Culverts

Important Considerations in their Design and Construction—What the Specifications Should Include—Factors Governing Choice of Structure

By W. J. MOORE
County Engineer, County of Renfrew, Ontario

Before Conference of County Road Superintendents of Ontario

Bridges and culverts are necessary in the construction of highways in order to allow of the safe passage of traffic over streams and ravines, and also for the flow of streams under the highways. In this latter connection there may have to be taken into consideration the designing of a waterway suitable for navigation or for the driving of logs in lumbering operations, as well as one suitable for the maximum flow of water which may occur.

Examination of Site

The first essential in the construction of a new bridge or culvert is a proper examination of the site. A survey should be made, taking in a strip of fifty or more feet on each side of the centre line of the highway and for as great a distance along it as will possibly be affected by the construction of the approaches. Levels and measurements should be taken along this strip sufficient to make an accurate contour plan. If there is an old structure there it should be measured up and enquiries made as to whether it has been of sufficient capacity to accommodate the stream at flood-times. High and low water marks should have their elevations determined and a cross-section of the stream bed should be taken along the centre line of the highway. Soundings and borings should also be taken to determine the character of the foundation. This is a very important part of the work and is too often neglected, the consequences being frequently disastrous.

Design

In the design of culverts a contour plan should be made of the strip of land previously surveyed and also a profile of the centre line of the highway for some distance on each side of the site. On these should be marked most of the information acquired during the survey. The next step is the determination of the area of the waterway. This may be done in one of three ways, viz: theoretically, empirically or by observation; and there are several factors which should be taken into consideration.

In the first place the size of the opening will depend on the amount of rainfall; which amount will be the maximum amount of rainfall for the time required by the run-off to reach the culvert from the most distant part of the watershed. For example, if it is found that it requires 30 minutes for the rainfall from the farthest point of drainage area to reach the culvert, then the area of the waterway should be designed for the maximum rainfall for 30 minutes as observed for the district in question. The figures for maximum rainfall for various districts may be obtained from the meteorological service of the federal government. I have been the observer at Pembroke for about ten years and the maximum storm during that time has been a rainfall of 1.90 inches per hour for a period of 35 minutes.

Not all of the rainfall on an area reaches the outlet, and the portion which does is known as the run-off. The amount of run-off is affected in various ways. The watershed may be long and narrow and covered with dense vegetation, and hence the flow of water may be retarded; or the soil may be of a sandy and porous nature and hence absorb more of the rainfall than if it were of clay. Then again, in a northern country it is possible to have a rainfall on snow accompanied by a thaw and this condition, in addition to the fact that the ground is frozen and practically impervious, may give rise to a maximum rate of run-off.

In a theoretical determination of the area of a waterway many assumptions would have to be made regarding the points mentioned above and the area arrived at by the use of the formulae for the flow of water in open channels. This is a laborious method, however, and owing to the many doubtful factors is hardly worth the trouble involved.

There are then the empirical methods by which certain formulae are used which have been derived from experience.

Observation of Existing Structures

Probably the best method, however, is by observation of the flow through existing structures and by enquiry from persons residing near the culvert. In railway practice before the days of the N. T. R. on which permanent structures were built at once, it was the custom to build temporary wooden culverts of ample dimensions. Each year the high water mark was observed and painted on the walls. In this way, after a lapse of eight or ten years when the life of the temporary structure had expired there was reliable data as to the size required for the new permanent culvert. Highway engineers are most concerned with roads which have been in existence for years and culvert or bridge work generally consists of replacements of existing works; consequently, much information may be required by observation and enquiry. Should the culvert be situated on a new location there will, no doubt, be other structures on the same stream either above or below the proposed work, observation of which will give all the data required.

In choosing the particular type of structure for a given location, whether it will be called a bridge or culvert is usually determined arbitrarily by whether the span is over or under fifteen feet in width. If a culvert is required it may be either a plain or reinforced concrete arch or a box culvert. Arches are chosen where the head room is sufficient for this type and where it is thought that a more pleasing effect may be obtained by their use. Box culverts are, however, used more generally, due to their suitability for sites where headroom is restricted and to the fact that the form-work on them is not so complicated as well as for the reason that the load is more evenly distributed on the foundations and less care need be exercised on this account.

Box culverts may be either open or closed boxes. In the former there is not a concrete floor and the load is carried on footings beneath the side walls while in the latter there is a reinforced concrete bottom which is designated to carry the load.

The length of a culvert depends on the depth of the fill on top of it. Assuming the slope of the fill to be 1½:1, then the length of the culvert will be the width of the roadway plus three times the depth of the fill over the top of the culvert.

Loading

Loading on culverts is generally considered to be the total weight of the fill above it for the full width of the excavated trench.

The unit weights most generally used are as follows:—

Partly compacted damp top soil	90 lb. per cu. ft.
Saturated top soil	110 lb. per cu. ft.
Dry sand	100 lb. per cu. ft.
Saturated sand	120 lb. per cu. ft.
Partly compacted damp yellow clay	100 lb. cu. ft.
Saturated yellow clay	130 lb. per cu. ft.

No allowance is made in fills less than 30 feet deep for the arching of the material above the culverts. In addition to this is the weight of the culvert itself which is generally figured as equal to a like volume of the superimposed earth.

Lateral pressure on the sides of the culvert is generally assumed as one-fourth of the pressure on top. The live load surcharge is added to the top soil pressure in designing top and bottom slabs. The top and bottom slabs are designed as simple beams supported at the ends but not fixed. Reinforcement in them is generally about 1 per cent of the total section. The transverse reinforcement is the most important but longitudinal reinforcement is also used as, due to unequal settlement, the culvert as a whole may be subjected to beam stresses. The side walls are frequently not reinforced but are made of ample dimensions to resist lateral pressure.

The bottom slab is generally of the same thickness and reinforcement as the top but in this the reinforcement is placed near the top whereas in the top slab the reinforcement is placed near the bottom.

End walls on culverts may be of three or more kinds. Some are built as continuations of the side walls with a slope equal to the slope of the bank; some are built at right angles to the barrel of the culvert while others are built at an angle of 30 degrees or 45 degrees with the side walls. The choice will be controlled by the desirability of providing a clear flow. They should be designed of sufficient weight to resist the overturning effect of the bank behind them and to resist the impact of all kinds of vehicles.

Reinforced Concrete Bridges

In recent years more and more reinforced concrete bridges are being built. The following are the kinds usually recommended for various conditions:—

1. A concrete arch or concrete abutments with reinforced concrete slab for spans up to 20 feet.
2. A concrete arch or a concrete beam bridge for spans from 20 feet to 40 feet.
3. Concrete arch for spans exceeding 40 feet.

Concrete truss bridges have also been used somewhat in recent years.

Arch bridges may be divided into open spandrel and closed spandrel bridges; in open spandrel bridges the load is carried on a system of beams and columns which rest on the arch, while in closed spandrel bridges the spandrel walls are built solid as retaining walls which confine the filling over the arch. Arch bridges are also classified according to the form of the arch as circular, multi-centred, elliptical or parabolic.

In a paper such as this it would be impossible to go thoroughly into the design of the different kinds of concrete bridges. It is sufficient to say that they should be designed by competent men and carefully supervised in construction. A point that should be emphasized, however, is that it is especially essential to have a stable foundation. Of all the failures of bridges that are recorded, by far the greatest cause is the neglect of attention to this rule.

Foundations for bridges are either natural or artificial. Natural foundations are (a) rock, (b) gravel, (c) sand, (d) clay. The following table show the allowable pressure per square foot to which the different classes may be safely subjected:

Rock in thick beds	25 tons per sq. ft.
Strong gravel & coarse sand (dry)	8 tons per sq. ft.
Compact sand or firm clay (dry)	4 tons per sq. ft.
Clay moderately dry	3 tons per sq. ft.
Clean dry sand not cemented	2 tons per sq. ft.
Wet clay	1 ton per sq. ft.
Quicksand and wet yielding soils	0 to ½ ton per sq. ft.

Dependence should not be placed on these tables unless it is impracticable to determine by test the bearing power of the foundation in question.

Foundations

Rock is generally a satisfactory foundation, but sometimes owing to the formation it is inadvisable to build upon it until it is levelled off or cut into steps. Gravel is a good foundation, but it is necessary to be sure that the stratum is sufficiently thick. Gravel may also be washed out from around a pier causing its failure. In the county of Renfrew this happened in two instances, during the past summer to bridges on the Madawaska River. At Stewartville a central pier was undermined by the action of the swift current, turned partly over and distorted the trusses on the adjoining spans. At Griffith also a similar thing happened. It is necessary, therefore, in locations such as this to carry the pier down a sufficient depth and, if necessary, protect it by rip rap, a concrete apron or otherwise.

Sand varies from the coarse variety almost approaching shale in its characteristics to a wet soupy material as unstable as quicksand. Sometimes in clay the strata are inclined steeply and a subsidence takes place which spells disaster. This occurred a few years ago at a bridge over the Madawaska River in the township of McNab and known as the Clay-bank Bridge. A short pier carrying the ends of two girder spans was overturned by a slide of the foundation material.

Artificial Foundations

Artificial foundations may be either of piles, grillage or cribwork. Of these the use of piles is the most universal and satisfactory. Piles may be of almost any variety of sound timber and should be straight. The bearing power of piles depends on the friction of the timber with the earth throughout its whole length and not on the bearing on the point alone as is sometimes popularly supposed. The bearing power is determined by the following formula:

$$P = \frac{2 \times W \times H}{S+1}$$

where P=safe load in pounds.
W=weight of hammer in pounds
H=fall of hammer in feet
S=penetration of last blow in inches

It must be remembered that on piers and abutments the pressure is not always uniform over the entire area. In abutments the pressure will be greater on the bridge side than on the approach side owing to the overturning effect of the earth fill; and in piers the spans may be of unequal length and thus cause more pressure on one side than on the other. Piles should therefore be spaced closer where the pressure is greatest.

A grillage consists of timbers placed side by side and across each other and drift bolted together. On this the pier or abutment rests.

Cribs consist of a grillage bottom with box-like sides and cross supports. These are floated into place and are generally filled with stones and sunk. They sometimes form foundations for concrete piers.

Specifications and Construction

Of equal importance as the proper examination of the site and a fitting design is the further elaboration of the project by complete specifications, a careful detailed estimate and finally the faithful following of plans and specifications in the actual construction.

Specifications, without being too verbose, should cover every particular of the work both generally and as to materials and methods.

General clauses should cover the following:

1. A general statement as to the scope of the work, and the supplying of labor and material.
2. Special work and alterations—clauses calling attention to special or extra work and the right of the engineer to alter plans and specifications and the method of payments or deductions from the contract price.
3. Unauthorized work, clause providing for nonpayment.
4. Public convenience and safety-clauses with respect to detour, liability for damages arising from accidents, lights, barricades and safety of the travelling public.
5. Lines, grades and measurements—statments as to their being made by engineer and stakes preserved by contractor.
6. Defective material and workmanship clauses calling for removal or making good.
7. Definitions—clauses defining terms used, as "Engineer", "Corporation" and so forth.
8. Conditions under which contract may be annulled.
9. Conditions of payment—clauses covering the payment at intervals for work and material, the method of payment and the final acceptance and payment.

Clauses Referring to Materials

Clauses as to material should cover the following subjects:

1. Reinforcement—clauses relating to the kind, to the shape, form and weights.
2. Cement—approval of brand necessary, testing, and instructions as to storage.
3. Sand—clause as to size and characteristics.
4. Gravel—clause as to whether pit run or screened and requiring it to be free from loam and clay.
5. Crushed stone—clause as to sizes allowed and as to quality.
6. Rubble—clause specifying when to be used ard size of stone allowed.
7. Lumber for forms—clause specifying thickness, kind, grade and whether dressed or undressed.
8. Clause covering wire, steel pipe, gravel for filling, tar, hand rails and other incidentals as required by the design.
9. Piles—kind and length.

Specifications as to methods should refer to the following:

1. Excavation and back-filling.
2. Pile driving—notes as to spacing and instructions as to when driving may be stopped and as to cutting off.
3. Unwatering.
4. Forms—clauses requiring them to be built true to line and well supported, may require to be oiled, debris to be removed.
5. Proportioning of materials—clause relating to the different volumes of materials to be mixed together to form concrete. The proportions may vary on the same work.
6. Mixing—clause specifying time of mixing, if by machine, and methods if by hand.
7. Placing concrete—clauses relating to laying, bonding, ramming and spading.
8. Protecting concrete—clauses specifying how protection is to be secured in both hot and dry and cold weather.
9. Placing reinforcement.
10. Removal of forms—time required to elapse before forms are removed.
11. Surface finish—clause as to whether surface is to be washed, rubbed, stuccoed, bush-hammered or otherwise treated and method of doing so.
12. Grading of approaches and surplus material.

Construction

As to the actual construction, the best method will depend on the particular work to be done and the conditions surrounding it. Attention should be paid to the qualities of the various component parts of the concrete. Except for large undertakings cement is not usually tested but is accepted as it comes from the factory. As a rule no serious results occur from this practice.

Aggregates, which constitute about 90 per cent of the concrete, are classified as coarse aggregates and fine aggregates. Coarse aggregates are all particles of gravel, crushed stone, or other materials above ¼ inch in diameter. Fine aggregates are all particles below ¼ inch in size. As the chemical and physical properties of the aggregates are not changed by mixing with cement and as they constitute such a large part of the concrete it follows that they should be the best to be obtained in the locality if good work is expected. This is, I think, if possible of more importance than the determination of the proper proportioning of the ingredients for the reason that the proportioning has been worked out by experiment for most classes of work and the results are followed by the majority of engineers.

With proper cement and aggregates it is yet possible to get an inferior concrete by improper mixing. After all the material is in the drum of the mixer, mixing should continue for at least one minute and the revolutions of the drum should not be less than 10 or more than 16 per minute.

Care should be taken in placing the concrete so so that separation of the aggregates may not take place and the concrete should be well rammed in place to fill up all voids and pockets. Care is then needed in protecting the work from the elements for a short time.

In conclusion I would point out that, in the use of concrete, highway engineers have a material which has already proved a great boon in the carrying out of road programmes and promises to be used to a greater degree in the future.

Treated Timber for Highway Work

Bridges Built of Treated Timber Have Long Life and the Cheapness of the Material Makes It Possible to Build Structures Wide Enough for Future Traffic Without Excessive Cost

By P. R. HICKS

Of American Wood Preservers' Association in "Engineering World."

We have come to realize that the only permanent feature of a highway is its location, and that the most perplexing problems involved in our efforts towards highway improvements are the questions pertaining to our drainage structures. While conditions affecting type of roadway, grade lines, width of right-of-way and location can be met and mastered by established precedents and past experience, there are many and varied causes which keep the bridge engineer in the "pioneer" class. His problems are as new and changeable as the structures that he is called upon to build, and no two of them may be said to be alike.

Unfortunately in the past and still more unfortunately in the present, too little attention has in too numerous instances been paid to certain details affecting the usefulness, efficiency, and life of drainage structures.

It is not the purpose to deal with the relative merits of the several different types of drainage structures and the kinds of material which are used in their make-up, but rather to call attention to one particular source of supply for the construction of our bridges and culverts which presents unlimited opportunities for saving millions of dollars in this vast country-wide movement for the improvement of our roadways.

Some few years ago, when the automobile was the main butt for the joke makers of the country, who could have conceived the traffic conditions of the present? And, following the same line of thought what can we, with our disjointed and spasmodic attempts at highway improvement, know of what conditions will be in 20, or even 10 years With the gradual improvement of the uncharted gaps in our vast network of proposed highways, and the resulting increase of our modern perfected methods of motor transportation, country lanes will become congested thoroughfares. It will then become a comparatively simple matter to widen the traveled way,—but what of the bridges and culverts?

Prematurely Useless

To-day, the greater number of bridges constructed provide for single passage roadways, comparatively few being over 16 ft. in width. Where supervision is employed, the structures are amply strong, as a rule, to meet all requirements, both present and future, when the "future" is limited to a reasonable number of years. But for what duration of time will our heaviest bridges of 15, and, in rare instances, 20-ton capacity prove sufficient in themselves to meet advanced conditions? Will not these bridges of today fail the tests of tomorrow, and prove eventual "weak links" long before their mechanical life is over and have to be replaced at great expense?

The question of strength is not the only feature to be considered here, for not only will increased loads require heavier bridges, and the growing volume of traffic necessitate the widening of the structures, but varying drainage conditions will tax the carrying capacity of our natural drains more and more. Increasing rapidity of the run-off of storm waters, caused by deforestation and improved drainage conditions, will require larger openings than are now necessary. There are vast areas of country which will be affected by these improved conditions. Can it be expected that drainage structures, installed to-day largely by guesswork, will effectively meet these increased requirements of the future?

The question, therefore, arises as to whether or not we should be influenced in constructing our bridges and culverts by these unknown factors, and make provision to meet future conditions in an economical and efficient way, so that our drainage structures may be strengthened, widened and lengthened without loss, or whether we should build to meet present conditions, and let the future take care of itself—come what may.

Timber for Structures

The logical answer to this problem is the use of scientifically treated timber for our drainage structures, both bridges and culverts.

Timber structures may be widened, strengthened and lengthened at will, without any loss of material or waste, and at comparatively little expense.

Practically, to date, the general use of treated timbers has been confined to a limited field, where extreme conditions have had to be met and overcome. While the large railroad corporations have been aware of the value of this product, and have been using it to advantage for many years, the adaptability of treated timber for highway work in general has not received its due recognition, even though its value as bridge and culvert material is readily conceded by anyone who is experienced in this particular field of endeavor.

Unfortunately, however, the theories of scientific timber preservation are little known to the general rank and file of construction engineers and contractors, and it is often difficult to overcome their skepticism and pry them away from set ideas based upon long established precedent.

One of the first obstacles to overcome in gaining recognition of the value of well preserved timbers is the difficulty of forcing upon the public the realization of the fact that there is a vast difference between "pressure treated" and plain or "untreated" wooden structures.

Treated Timber Necessary

In this day and time, with the tragedy of our rapidly disappearing forests confronting us, it is criminal negligence and waste to build any structure, which is exposed to the destructive elements of nature, of untreated timber. Not only is it contrary to all questions of economics to install a bridge or culvert of material which will have to be replaced within a few years. but the demands made upon our timber supply by these easily avoidable renewals cause serious inroads on our already overtaxed remaining timber supply. Construction of this sort should be discouraged in all lines of improvement. On the other hand, the preservative treatment, correctly applied in accordance with modern efficient pressure methods, gives an added life of at least five times that of natural wood, which alone means that a new supply of timber could be (and should be) grown during a minimum life of the bridge. These facts, which so closely demonstrate the difference between the timber "before and after treatment," must be recognized by the layman before he realizes that the well treated structure is a permanent structure, and is not to be confused and classed with the ordinary wooden bridge.

Once we realize that treated bridges and culverts are properly classified in the list of permanent structures we can direct our attention with open, unbiased minds to the outstanding features which make this form of construction attractive to the practical road builder.

Advantages

Engineers who have been engaged in the supervision of various types of bridge construction have gained, from experience, a most favorable impression in regard to the particular suitabiliy of treated timber drainage structures in highway work. The most attractive features of this type of construction are:

1. Initial low cost of high-grade materials, which are readily obtainable at all times.
2. Ease of transportation and handling, with no risk of loss due to deterioration or damage before installation.
3. Placing of material with a minimum amount of equipment, thereby greatly reducing operating expenses and overhead.
4. The installation of lumber and piling with unskilled, low-priced labor—often locally secured and easily managed.
5. Elimination of all form work and false work, thereby avoiding large items of expense and delay.
6. The reduction of foundation difficulties to a minimum, due to the practicability of driving the treated piling to a proper bearing capacity without additional expense.
7. Absence of necessity of painting at time of erection, or at any other time during the life of the structure, and complete elimination of all possibilities of unsightly workmanship due to poor form work.
8. Ease and low cost of enlarging and strengthening, both in regard to width of roadway and length of structure, when such improvements are made necessary by increased traffic conditions and improved drainage.
9. Reduction of upkeep and maintenance to a minimum.
10. Low initial cost of structure completely installed, with consequent saving of funds which may be advantageously applied to extra road work or higher types of surfacing.
11. Progress of work never impeded by adverse weather conditions.

The greatest physical disadvantage to be overcome in the future enlarging of permanent structures will be in regard to the widening of roadways. It is now generally recognized that the minimum width of a modern graded road should not be less than 24 ft. Yet, but few bridges of to-day provide for more than 16 ft. of travelway in the clear. With the advent of automoble traffic, this width hardly permits of the safe passing of vehicles upon the structure.

It is the opinion of many that the drainage structures should be as wide as the grade, and the only logical reason for the dangerous practice of narrowing the roadway at the bridges is because financial conditions necessitate a saving being made somewhere. Unfortunately, the efficiency of the drainage structures is made to suffer the burden of this false idea of economy, and while such practices may "get by" at present, the day of reckoning is not far ahead when the falsity of this mistaken line of logic will be realized.

Bridges of Sufficient Width

Due to the fact that treated timber structures can be installed far more economically than any other type of permanent work, it is now possible to overcome the serious mistake of faulty construction in regard to the width of bridges. In fact, the difference in this cost is so marked that permanent bridges of ample width of roadway can now be installed at equal or less cost than expensive types of so-called permanent structures of insufficient width.

These statements are not mere theorizing but are based upon actual facts and figures, which can and should be thoroughly investigated by those who are prone to be skeptical.

For anyone to realize thoroughly the extent to which the process of modern treatment actually lengthens the life of timber, it is necessary to make more than a cursory examination of this interesting subject.

From point of service, there are structures which have been in use for over 35 years and which give every indication of still being in use for many years to come.

Instances are on record where treated piling, after years of service under extreme conditions, has been salvaged and re-driven in new work of permanent design.

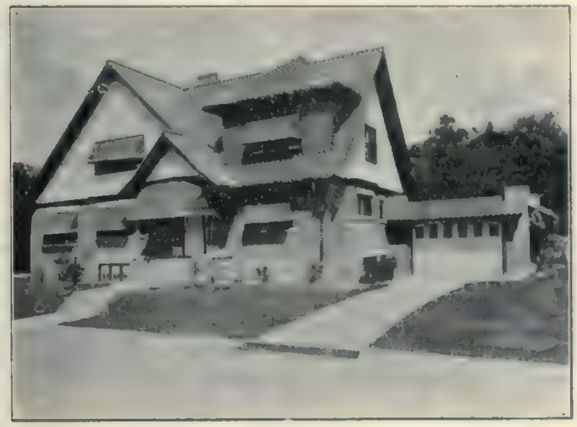
Attention has been called to the use of treated timber for drainage structures only, not taking into consideration the adaptability of this product for the highest type of surfacing.

Reference is here made to the creosoted wood block type of pavement. Without fear of contradiction, it can be safely stated that, as a wearing surface, this particular material is second to none. Of course, the development of our highway system has not yet advanced to such a point of proficiency that wood block surfacing can be given general consideration, except in the vicinity of large centers of population, where traffic conditions warrant the laying of the highest types of pavements. With the perfecting of our general highway system and the resulting increase in traffic, both in volume and tonnage, this class of surfacing will be more and more in demand.

No attempt will be made here to discuss the various types of bridge designs, or the method of treatment of timber. Varying conditions affecting different locations will have the effect of determining what specification should govern in each individual case, and it must be left to the good judgment and experience of the engineer in charge to determine what will give the best results.

The Contract Record's

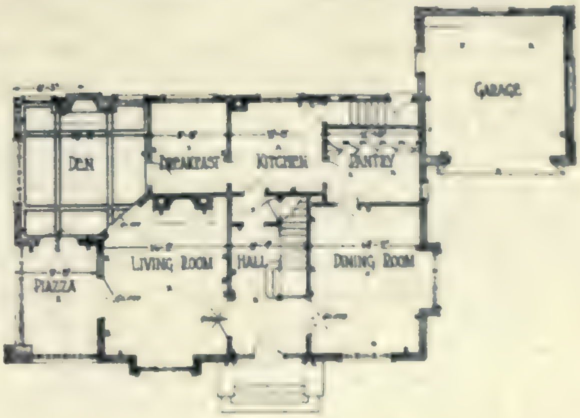
Weekly House Suggestion No. 12



The residence illustrated herewith was completed recently at the corner of Wells Hill and Lyndhurst Avenues, Toronto, for Mr. G. Flick. The exterior construction is made up of Credit Valley gray and piebald stone, Milton pressed brick and rough stucco. Ludowici Spanish roofing tiles were used for roofing both the house and the garage. The dining room, as indicated on the reproduced ground floor plan, is situated to the right of the front entrance. This room is panelled to a height of 6 ft. in Spanish mahogany. The pantry and kitchen, located off the dining room, are finished in white enamel and tiled to a height of 5 ft. The hallway which runs through the centre of the house, is finished in white enamel and mahogany, which scheme of decoration is carried out in the stairway, the treads and handrail of which are in mahogany, while the risers and balusters are in white enamel. The living room is designed more on the colonial type and is furnished in a tone just off the white. The walls in this room are panelled and the ceiling has a large cornice. The den and conservatory are conveniently situated off the living room, as seen in the photograph of the interior. The beams and trim in the den are of gumwood, finished a light walnut. The conservatory is done in a light gray, with red quarry tile flooring and a stucco ceiling. The woodwork upstairs, throughout, is finished in white and mahogany. The bathroom is accessible from the hall and from the main bedroom, the walls being finished with a 3 x 6 in. tile and the floors with a 1 in. hexagon tile.

There is a large billiard room in the basement, besides ample room for heating plant, coal storage, etc. The heating system is a Spencer hot water type, installed by R. Steen. The stone work was executed by Messrs. Hawken & Kelly; the wood work by S. R. Hughes & Son; the stucco work by John Boyce & Sons; plumbing by I. Maude; painting by London Bros.; electrical work by J. W. Commeford, and the roofing tile was supplied by the Roofers Supply Company.

Mr. J. A. Thatcher, Toronto, was the architect.



Bituminous Treatments on Macadam

(Continned from page 218)

Various systems are used for handling sand or gravel. In town or city work, it may be deposited in little piles along the road, twenty or thirty feet apart, from which it is spread direct, by men with shovels. In county work, on roads where there is no curb, these small piles of sand have a tendency to shrink before the time comes to use them, as they are easily dissipated by the traffic. Another system is to dump the sand, or gravel in two-yard piles, spaced 150 feet or more apart and rehandle it from these piles, using a couple of one-horse dump carts. Five or six experienced laborers with two dump carts will cover about three-quarters of a mile of eighteen-foot road per day under favorable conditions. In this connection it will be found that spreading sand for this purpose is an art in which every laborer is not proficient and the success of which is largely influenced by the skill of the men who do the spreading. Mechanical spreaders may also be used where conditions are suitable.

Mainly Constructional

East and West—From Coast to Coast

Providing labor conditions and the money market are favorable, Winnipeg will see from 800 to 1,000 new houses erected this year, according to estimates of civic officials.

A recent report states that a large 24-suite apartment house is to be erected on King St. W., Toronto, at a cost in the neighborhood of $125,000.

It is announced that 300-ft. steel bridge, with concrete piers and abutments, will be built over the Coquitlam River, in British Columbia, replacing the old structure which was washed away during the heavy floods last fall.

The employers of labor in the building industry, at Ottawa, it is stated, will ask the men in all branches of the industry to accept a general cut of 10 cents per hour this year. It is not known yet how the men look upon this proposal.

A report from Sarnia states that the Pere Marquette Railway Company plans the erection of a $350,000 bridge, of the Jack-knife type, over the Black River, to replace the present drawbridge at this city. It is proposed to commence actual construction work on this structure this year.

A settlement has been reached, it is stated, in the altercation between the county of Elgin, township of Malahide and the Provincial Department of Highways, in connection with the financing of a proposed bridge structure over Stalter Gully, in the above township. The following proportioning of the cost, as proposed by highway department engineers two years ago, has been approved finally by all parties interested and no delays, other than the usual preliminaries of O. K.'ing by the various officials, are anticipated in getting the actual construction work under way. The township of Malahide will be assessed with 30 per cent of the total cost of construction and maintenance; the county, 30 per cent and the Department of Highways, 40 per cent. It is thought the structure will cost in the neighborhood of $40,000.

The Canada Cement Company has scrapped the old cement plant at Shallow Lake, near Owen Sound, Ont., taking part of the machinery to their Lakefield plant. This plant, which was at one time one of the largest cement manufacturing plants in Canada, has been inoperative for the past 15 years.

Progress reports on the Mount Royal hotel construction work at Montreal, state that to date steel framework has been erected to the eighth bedroom storey and work is going rapidly forward on the installation of the heating, lighting and other auxiliary services. The steelwork up represents 90 per cent of the total required.

The International Tank & Silo Company, Limited, have decided to locate at Galt. It is stated that the company proposes erecting a large manufacturing plant, on a four acre site purchased for this purpose, early in the spring. The company will manufacture the lines of the Endlock Manufacturing Company of Des Moines, Iowa, consisting of silos, water tanks, grain bins, etc.

Building permits issued, at Toronto, since the first of the year represent a value twice as great as that of last year for the same period. The figure for the first two months of last year was $1,322,391, compared with $2,789,159 for January and February this year. During last month permits issued totalled in value approximately $1,600,000, as compared with $777,775 for February, 1921.

A new association, known as the Eastern Ontario Good Roads Association, has been formed, to promote the building of good roads in that part of the province. The headquarters of the new association is located at Kingston, and it is announced that a convention is being planned for some time within the next few months, for the formulation of new plans for the development of roads in the east.

Personal

Major H. C. McMordie has been authorized by the Militia Department to organize a company of engineers at Windsor, Ont., the unit when organized to be known as the 11th Field Company, Canadian Engineers. Major McMordie, M.C., is located at 4 Imperial Bank Building, Windsor, Ont.

Mr. W. C. Smith was recently appointed town engineer of Oshawa, Ont., succeeding Mr. G. Macdonald. Mr. Smith will also take over the duties of Mr. N. Goebel, as water works engineer, in the town's reorganization of the municipal works department.

Mr. John Wilson Jr., who for the past fifteen years has been associated with the sales organization of the Dominion Bridge Company, and its subsidiary companies, the Dominion Engineering Works and the Structural Steel Company, has accepted the position of sales manager with the Walsh Plate & Structural Works of Drummondville, Que. Mr. Wilson assumed his new position on March 1.

Mr. Sidney B. Johnson, Senior Assistant Engineer, Dominion Department of Public Works, addressed a meeting of the Ottawa Branch of the Engineering Institute of Canada, at the University Club in that city recently, on the topic of the advancement in hydrometric studies and the stream flow of Canadian streams and rivers during the past 17 years.

Trade Incorporations

Prost-Forde-Westell, Limited, with head office at Windsor, capital $100,000, to carry on the business of contractors and building supply dealers.

Northern Sand & Gravel Co. Ltd., with head office at Sarnia, capital $225,000, to deal in sand and gravel, and other building materials.

Obituary

Mr. George Wright, a member of the firm of Wright Bros., builders of Galt, Ont., died recently in that city from an attack of heart disease. Deceased was born in Tottenham, England, in 1869, and came to Canada, settling in Galt, 15 years ago.

ESTABLISHED 1886

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Unions See the Light

Labor can be said to be getting the right viewpoint on industrial relations when it is willing to subscribe to an agreement such as the one, detailed on another page, recently effected between representatives of the United States government and the Bricklayers', Masons' and Plasterers' International Union of America. By the arrangement determined upon, 119,000 workers henceforth agree to a set of working rules that are the fairest we had yet seen incorporated in any labor decree—fair because they recognize the rights of all parties involved in the work in which the union is interested, employer, mechanic and supply man. The way is paved, through the elimination of such scandalous actions of the unions as were disclosed in recent investigations, for the assurance to contractors of a fairer market for both labor and material; to supply men, of freedom from blackmailing actions of the unions and, to workmen, of the removal of factors that have minimized efficiency and throttled ambition.

The decree recognizes four major principles, as follows: (1) the productive capacity of the individual workman should not be limited; (2) employers have the right to purchase their material wherever, whenever and from whomever they may choose, irrespective of whether these materials are union-made or not; (3) organized labor must show no favoritism toward employer or trade organizations and must show no discrimination against employers who may not be members of such organization; (4) the labor organization is not to be used by material men or contractors as an agency for the enforcement of claims or debts.

Each of these principles is worthy of extended comment, for the labor organization that honestly subscribes to and acts upon these working regulations will be helping to a wonderful extent to establish happier industrial relations in the construction industry. Suffice it to say at this time that by making it obligatory for the 119,000 workers of the Bricklayers', Masons' and Plasterers' International Union to comply with these rules, a splendid example is being set that will surely react to the benefit of the building mechanic, the contractor, supply man and the public. And in this, no legitimate object or aim of unionism is being sacrificed, but, rather, the status of unionism is being enhanced by giving the ambitious workman full and ample opportunity to rise above the level of his inferior co-workers. Reduction of productive capacity, long one of unionism's policies, is bound to go if other labor organizations follow the precedent set by the Bricklayers', Masons' and Plasterers' International. Other illegitimate restrictions imposed by the unions in the past are also doomed by this decree to pass out of existence, or, at least, be minimized. Indeed, there is no doubt but that a successful application of the principles mentioned will help very materially to remove the bad odor from trade unionism.

Quebec's Motor Truck Restrictions Are a Hardship to Contractors

As the rule, the government of the province of Quebec, adopts policies of a progressive character, as for instance, the conservation of forest wealth and the support of the good roads movement, entailing a very large and continuous expenditure, part of which is borne by the general tax-payers. After all, however, ministers of the government are politicians as well as administrators and have their ears and eyes wide open to the opinions of the rural voters, who form the majority of the electorate. This, no doubt, is the explanation of the policy behind the government's bill amending motor laws, which raises the taxation on trucks and cars, restricts the operation of heavy trucks, and limits the speed.

The legislation wll affect the business of those contractors, structural steel manufacturers, and supply houses who use trucks, having found by experience that trucks are cheaper to operate and more efficient than horses. Motor trucks are also being increasingly employed in building and road construction, and the proposals of the Quebec government are calculated to add to the cost of these operations.

The new bill is far-reaching in its effect. The annual tax on trucks is doubled—$50 per ton instead of $25—while the restrictions are oppressive in that they prohibit the use of 5-ton trucks outside of the cities. The law is admittedly aimed at the use of the heavy truck, a type which is freely employed by general and road contractors; in fact, a member of the government bluntly stated that he desired to see this class of vehicle abolished. Those contractors who have invested large sums in heavy duty trucks will, under the bill, be unable to fully employ their vehicles, seeing that their operations are restricted to the cities. In this way, a portion of the investment will be lost, and at a period too when it is imperative to reduce to the lowest point the cost of building and road construction. Not only is the tax on trucks calculated to discourage the expansion of an industry which has been making rapid progress, but the new laws will militate against the economical operation of the vehicles, if we are to accept the statements of owners of the trucks.

A depution of owners of cars and trucks—several of them members of the Canadian Good Roads Association —which waited on the Quebec government, received a positively chilly reception. They were told in plain language that they were destroying the roads, that they would have to pay more towards the maintenance of the highways, and that if they strenuously objected, steps might be taken to absolutely abolish the five-ton truck. It is admitted that motor cars and trucks, in common with other vehicular traffic, damage the roads, but that is surely no reason for restricting the use of cars and trucks and unduly taxing the proprietors; it is rather a reason for building better roads which will meet modern traffic conditions. The Government's policy is, we think, based on a wrong conception of present day needs—it is an endeavor to "put back the hands of the clock."

The motor truck is with us to stay and although artificial barriers of the kind proposed may prove effective for a time, they will not stop the use of economic and rapid methods of transportation. In this case it looks very much as if provincial politics are responsible for this retrograde legislation.

On the question of the good roads programme, the premier told the deputation that the government proposed a vigorous policy in maintaining the highways. The government would have its own staff and machinery for maintenance if the municipalities wanted it. The municipalities would have to pass a by-law authorizing the government to maintain the roads in the district and would have to pay a share of the cost, but the work would be done by the government men and machinery and under the control of government engineers. Besides this, the government was giving a million dollars for road work and also proposed to raise an additional quarter million from car and truck owners, the object being to maintain the roads in a better condition.

A Duty For Architects to Specify Canadian Materials

In an article on the made-in-Canada movement appearing recently in the Montreal Herald, emphasis was laid on the part that can be played by architects in furthering the use of Canadian materials in building. This is a point well taken and it has already been dealt with at various times both in the Contract Record and in bulletins issued by the Canadian Manufacturers' Association. This article reads:

"A peculiarly heavy obligation rests upon architects who prepare specifications for materials and equipment.

"In some cases United States architects are employed and these are in the habit of specifying United States goods, because they are not acquainted with the products of this country. Even in the case of architects of Canadian birth, many have had their training in the United States, and frequently, through lack of information relative to Canadian goods or lack of experience with Canadian products, they call for materials or supplies of United States production.

"In some instances, public bodies which are anxious to support the made-in-Canada campaign to the fullest possible extent, have allowed specifications to be issued in which imported articles are called for, by direct mention of the name of manufacturers abroad, with or without some qualifying clause permitting the use of some "equal" alternative. In this way the use of the imported commodities is impressed upon the mind of the contractor and he must take the full responsibility if any objections, justified or unjustified, are made to any alternative goods which he may substitute. Recently the school board of two large Canadian cities issued specifications calling for foreign-made master clocks and signal gongs as equipment for collegiate institutes. These specifications apparently were drawn up by their architects thoughtlessly or in ignorance of the fact that similar equipment, at least equal in quality to, and comparing favorably in price with, the imported equipment, was made by Canadian workers, in plants in Canada which buy Canadian material and pay taxes in the Dominion.

"There is a duty also upon public bodies, private companies and individuals throughout Canada, to insist that the architects who prepare specifications for them, should call for Canadian products to the fullest extent consistent with the obtaining of satisfactory results at favorable prices. Responsibility also rests upon Canadian manufacturers and other producers to keep architects acquainted with their products by distribution of catalogues or otherwise."

Buildings Contemplated in Nova Scotia

The following is a list of work contemplated in the portion of the province of Nova Scotia served by the Dominion Atlantic Railway Co. For the information we are indebted to this company:

Kingston, N. S:—Maryland Fruit Company, warehouse, 150 x 40; Messrs. Oakes, Church Ward & Devine, warehouse, 175 x 45; Messrs. Cleveland, Foster & Saunders, warehouse, 125 x 40.

Aylesford, N. S:—Messrs. Oakes, Nichols & Ilsley, warehouse, 200 x 45.

Lakeville, N. S:—Lakeville Fruit Company, warehouse, 100 x 40.

Sheffield Mills, N. S:—Perry Rand, warehouse extension, 25 x 40.

Port Williams, N. S:—Cornwallis Fruit Company, warehouse, 150 x 40.

Round Hill:—New D. A. R. station and freight shed.

Grand Pre:—D. A. R. 40,000 gallon tank.

The following buildings are now in course of construction:

Kentville, N. S:—Warehouse and factory for United Fruit Companies of Nova Scotia, Ltd.; Spray dust factory, Niagara Dust Company.

Walker and Gibson, architects and engineers, 70 Victoria St., Toronto, have been retained by the trustee board of school section No. 11, Etobicoke, to design and supervise the construction of a six room addition to the present school building, the addition to include an auditorium and a gymnasium. The old building is to be overhauled and made more fire proof.

E. R. Seabrook & Co., dealers in contractors' supplies, factory equipment, etc., have recently opened offices at 118 King Street, London, Ont., to handle building supplies, for the Cooksville Shale Brick Co., Metallic Roofing Co., Asbestos Mfg. Co., Bancroft Marbles Ltd. and The Canada Stoker Co.

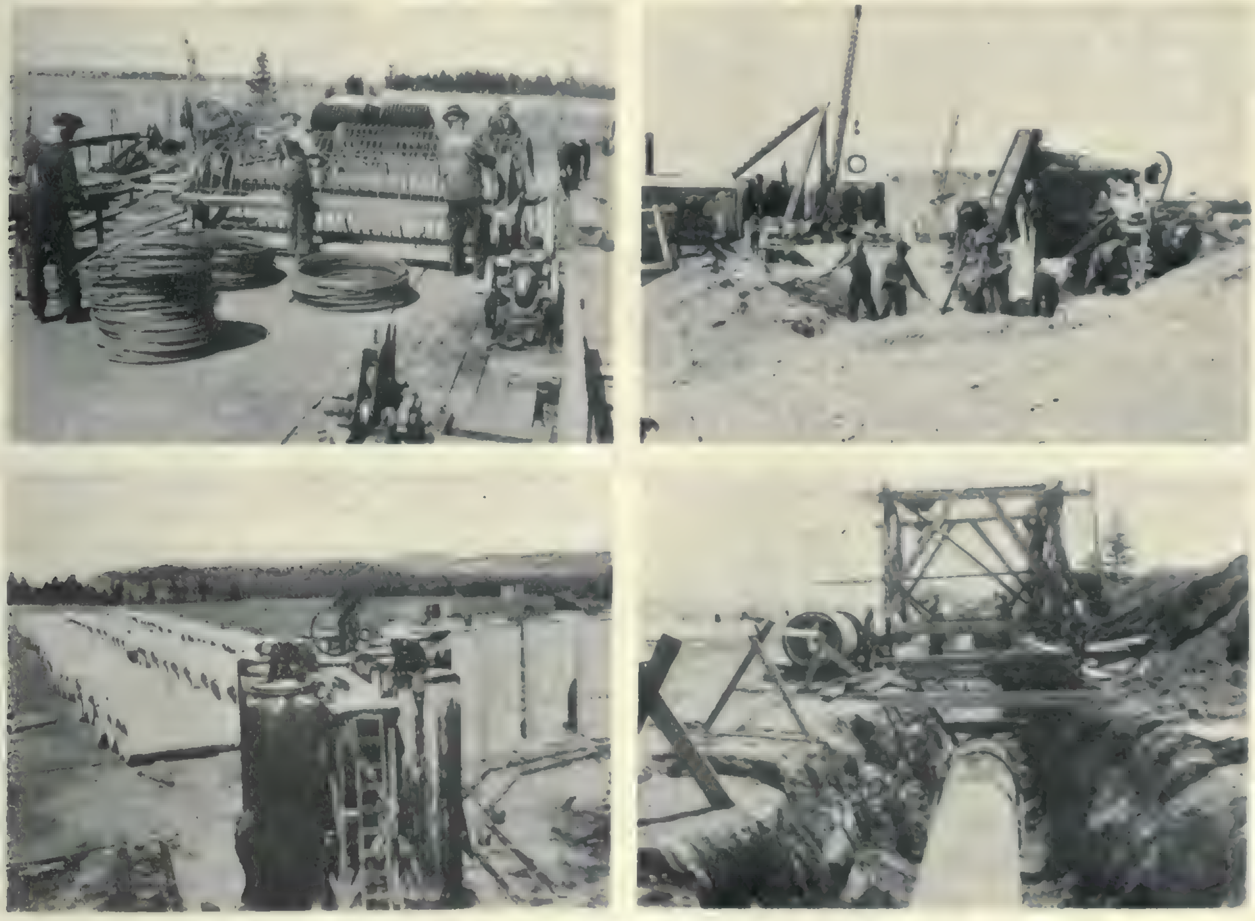
New Reinforced Concrete Pipe Line Supplies Water to St. John, N.B.

Cement Lined Iron Pipe and Cast Iron Pipe Supplemented by a Main 4 Miles Long, Comprising 36-inch Pipe, Manufactured in 12 ft. Sections with Special Lead Gasket Joint — Construction Is Flexible and Water Tight Under All Conditions of Temperature

By W. G CHACE
Canada Lock Joint Pipe Ltd.

The fast growing demands of large industrial plants at St. John, N. B., for water, necessitated the laying of a new reinforced concrete pipe line last year, supplementing the supply from Spruce Lake and Ludgate Lake, now one body of water with a drainage area of 9 sq. miles. This article deals with the construction of the new pipe line.

To briefly review the history of this supply line:—In 1856 the first line was laid, 12 in. "cement lined pipe" being used. This pipe consisted of a sheet iron cylinder in foot lengths, lined and coated with cement and was known as "Ball's Patent Indestructible Cement Pipe". A report of the City Water Department, in 1895, stated that this pipe was fully maintained to that date, requiring only an occasional flushing.



Upper left: Placing reinforcement for a 18 ft. section of pipe. Upper right: Screening and grading aggregate Lower left: Forms in which the pipe are cast. Lower right: Laying pipe in trench

In 1899 a 24-in. cast iron pipe line was laid along the same route, this being necessary to supply the demand of a large pulp mill industry and, further, because the difference in elevation between Spruce Lake, 181 ft. above mean sea level, and the town itself, was comparatively small. These two lines were adequate to satisfy the city's demands until 1920, when the pulp company, in signing a new agreement with the city, asked for more water. It was decided at this time to lay a 36 in. reinforced concrete pipe line, four miles in length, which contract was carried out in 1921 and is described herewith. It is stated that the only weak spot in the original pipe line, where "cement lined pipe" was used, was at the joints; the steel plate, where the cement coating is not broken, is in perfect condition even to the present day.

The new reinforced concrete pipe line is laid along the Manawagonish Road, between West St. John and Fairville, as the eastern terminus, and Spruce Lake, as the western terminus.

Design of Pipe

This pipe has a four-inch wall and is made of concrete, reinforced with steel bars and triangular wire mesh. It is built in twelve foot lengths, into one end of which is moulded a cast iron machined bell ring and into the other end a cast iron machined spigot ring. The process of manufacture (see photos) involves the securing of these two rings, along with the longitudinal and circumferential reinforcing steel into a firm cage pipe, which cage can be handled as a unit and the elements of which are securely fixed in the proper positions with the result that each linear foot of pipe as manufactured has located within it exactly the quantity of reinforcement designed and at the exact spacing desired. Six longitudinal bars of ⅝-inch round steel serve as the framework of the cage and at the same time by means of hooked ends they secure at proper distances the cast iron bell and spigot rings. To these longitudinal bars are secured the circumferential mesh or bars, as the case may be. When circumferential bars are used these are each tied firmly to each of the longitudinals by means of crimped steel ribbon 1/16 x 3/8-inch; the crimps in each ribbon are at the proper centering for locating the bar hoops. The pipe under contract is for use under hydrostatic heads of from 20 feet to 78 feet, corresponding with the elevation of the trench bottom along the profile of the line.

An idea of the distribution of these various heads and of the reinforcement which has been chosen to suit each conditions is given in the following table:

Class A—27-ft. head, No. 208 mesh. Class B—35-ft. head, No. 267 mesh. Class C.—40-ft. head, No. 309 mesh. Class D.—47-ft. head, No. 365 mesh. Class E—61-ft. head, 28 pieces of ½-inch round per 12 ft. of pipe. Class F—70-ft. head, 32 pieces of ½-inch round per pipe. Class G—78-ft. head, 28 pieces of ½-inch spuare per pipe.

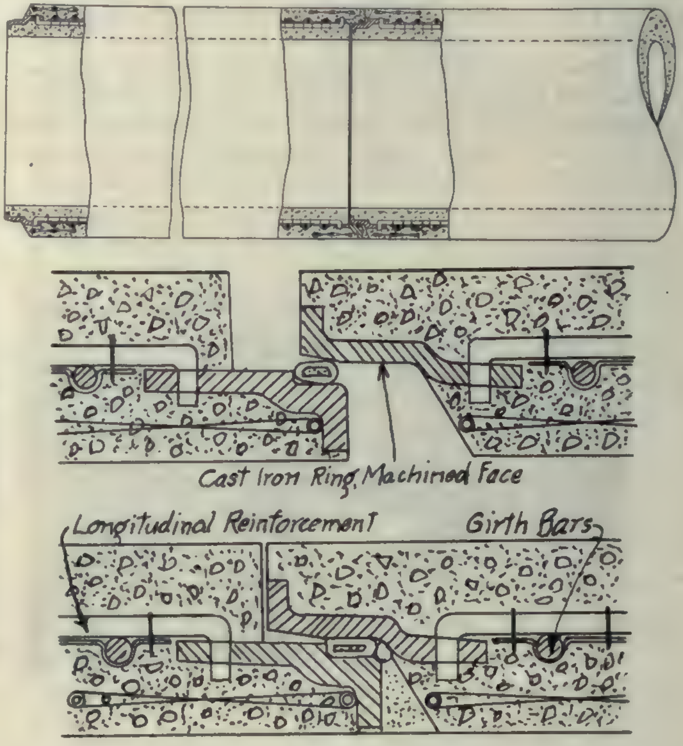
The steel in this pipe is designed for operations under static head at a stress of twelve thousand pounds per spuare inch. The bar in each hoop is lapped on itself thirty diameters and these laps in consecutive hoops in the cage are spiralled around the periphery.

Concrete Aggregate and Method of Casting

The concrete used in the manufacture of this pipe was all screened sea-beach gravel and sand, the maximum size gravel being about ⅝ inch in diameter, all over size being crushed. This class of material, which was the only material available for the purpose, was quite harsh although fairly graded, and to overcome this defect, which would otherwise have caused segregation during the pouring of the concrete and leakage through the wall of the pipe thereafter, addition of about two per cent. of clay was made, the result being a very "fat" mixture and one which flowed easily into the narrow forms and thoroughly about the reinforcing steel with a minimum of separation of the stony aggregate and a minimum loss of the water of the concrete. This class of concrete is necessarily poured quite wet though not so wet that the gravel or coarser particles will sink or fail to float in the fluid mass. In order to insure a watertight body round about the bell and the spigot rings these portions of the pipe were moulded with mortar rather than with concrete. The pipes were cast on end within steel forms and the deposited concrete was thoroughly sliced and worked, special care being given to the complete and thorough filling and working of the upper or spigot end of the pipe wall.

Pipe Moulding Forms

The forms within which this pipe is moulded consist of cylinders of 3/16-inch plate, carefully assembled to accurate dimension. When in upright position the inner and outer forms rest upon finished cast iron base rings, being held in respective proper positions by means of circumferential beadings upon these bases. For the manufacture of twelve pipes per day or 144 feet of pipe, thirty-six of such bases were in constant use along with twelve inner and outer forms and twelve spigot moulds. In order to release these forms each day the temperature of the fluid concrete is kept in the neighborhood of 100 degrees by means of heavy duck coverings. The inner and outer forms are so designed as to be capable the one of contraction and the other of expansion so that each may be lifted clear of the comparatively green concrete pipe without injury thereto. The surface of these forms is kept absolutely clean and true and is oiled before being used. This practice of oiling metal surfaces is applied throughout the entire job to all vehicles or containers of the wet concrete, such as the mixers and concrete distributing bucket and the concrete chute or hopper which receives the product of the mixers. This precaution is valuable as preventing the accumulation and accidental inclusion of dead concrete within fresh concrete.



Details of pipe used in St. John, N.B.

The joint which is used for this line of water supply is one which was devised during 1917 by the owning company of contractors and pipe manufacturers. It has been thoroughly tried out in the shape of models and of full sized test sections from 15 inches to 48 inches in diameter in various parts of the Continent. It has been applied to water service for Kansas City, for Cumberland, Md., in Massachusetts, and during 1921 was also built into five miles of line for Norfolk, Va., which latter proposition was also of thirty-six-inch pipe.

Formation of Joint

As stated above, this pipe carries a machined cast iron bell and a machined cast iron spigot, (see line drawing.) Within the bell casting is cut a wedge-shaped groove of about ¾-inch width; the surface of the spigot ring is finished conically for part of its length and cylindrically for the remainder or working portion of the length of the spigot ring. The joint between spigot and bell of consecutive pipes is made water-tight by means of an elastic lead pipe gasket. This gasket consists of a relatively light weight lead pipe of diameter not exceeding ½-inch standard, within which pipe is drawn a good filling of cotton wicking. The lead pipe, so filled with cotton, is cut to proper length, rolled to an elliptical section and then soldered into a complete hoop. This hoop is of diameter to fit into the wedge-shaped groove in the bell casting, and the gasket is then caulked by forcing the adjacent pipe into place, the taper end of the spigot wedging the gasket radially into its seat so that it ultimately rides upon the cylindrical surface of the spigot. The assembly of such a joint requires considerable longitudinal force. This is applied in a simple manner by means of long bolts and a strong back. The work in the trench is limited to this assembly and can be carried out in all weathers and under all trench conditions, even when the trench floor is submerged. All working surfaces having been finished to template, there is a certainty of easy and uniform fit at each joint; this type of joint has been proven water-tight under high pressure and even by use of steam pressure up to a temperature approaching the melting point of lead. The joint when assembled is flexible and will take care of irregularities in the settlement of trench foundation; and it is a true expansion joint, its water-tightness not being affected by changes in the temperature of the flowing water which will cause changes in the gross length of the pipe line. A continuous cylindrical inside surface is provided in a pipe so designed with a resultant large capacity.

In choosing reinforced concrete as the style of pipe for this its third line from Spruce Lake, the city engineers and administrators had taken into consideration that reinforced concrete pipe is one whose capacity is large because of its continuous and smooth interior surface; because of its permanency; because its water-tightness increases with age; because it is rigid and strong when placed as this line perforce is placed under a traveled roadway; and because an outstanding characteristic of reinforced concrete pipe is its certainty of continuing to supply water even though unforseen rises of pressure might cause fracture of its walls.

Whereas the 24-inch line from Spruce Lake to West St. John occupies in a large part a private right of way, this new thirty-six inch line occupies almost throughout a portion of the principal highway leading westward and known as St. Andrews or the Manawagonish Road. The soil is mostly of loamy gravel and trenching conditions do not promise great difficulties. Excavation was done by means of a Keystone machine and the earth was replaced over pipe by means of an Austin backfiller. Fortunately the material of excavation was of such a quality that the excess could be distributed as road metal.

The work was carried out by the Council of the City of St. John operating through its Commissioner of Water and Sewerage, Mr. J. B. Jones, and its City Engineer, Mr. G. G. Hare. The contractors were Canada Lock Joint Pipe, Limited, who operate in Canada in the water and sewerage field under the patents of Lock Joint Pipe Co. of New Jersey, U. S. A.

Bridge Building in the Province of Quebec Is Very Active

The Department of Public Works Has Been Very Busy Meeting Requests for Subsidies—Over Five Million Dollars Spent in Last Thirteen Years

Although lack of work and industrial uneasiness are felt pretty much universally and industry is not as prosperous as one would like, it is otherwise with regard to the building of iron bridges in Quebec province. According to the annual report of the Minister of Public Work, this work has never been so active as during the past year. Although the staff of engineers has been increased, the department can hardly answer all the requests coming to it from all parts of the province. The activity so displayed by the government in the building of iron bridges has greatly contributed to the solution of the problem of lack of work in the province. "It is a policy highly appreciated by the public," states the report, "and we hope that in the near future the greater portion of wooden bridges in the province will be replaced by permanent ones. We may add that our engineers endeavor, whenever the site is suitable and other considerations do not intervene, to recommend the building of iron or reinforced concrete bridges.

"As in past years, the department has worked with much zeal notwithstanding the difficulties of the problem of the maintenance of bridges subsidized by the government, and we never can insist too strongely upon making the municipalities realize the importance of giving special attention to such maintenance.

The following table shows the activity displayed by the department of public works, in connection with road bridges:

Number of bridges built from the 1st of July, 1908, to 30th June, 1921 .	632
Cost of bridges built	$ 5,083,579.09
Total length of superstructure of bridges built	62,629 ft.
Government grants for bridges built .	$ 2,803,875.67
Number of bridges built from the 1st of July, 1920, to 30th June, 1921 .	58
Number of bridges in course of construction on June 30, 1921	55
Total length of superstructure of bridges in course of construction on June 30, 1921	6,238 ft.

Construction Developments During the Month of February

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, February, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	....	$..........	4	$120,500	....	....	....	....	4	$120,500
Churches	5	105,000	5	509,000	....	....	....	....	10	614,000
Factories	4	125,000	2	35,000	....	....	....	....	6	160,000
Public Garages	[illegible]	35,000	1	6,500	....	....	....	....	3	41,500
Hospitals	1	75,000	....	....	1	19,000	....	....	2	94,000
Hotels and Clubs	1	80,000	....	....	....	....	....	....	1	80,000
Office Buildings	....	....	1	15,000	1	15,000	....	....	2	30,000
Public Buildings	3	14,500	1	15,000	....	....	....	....	4	29,500
Residences	400	2,686,000	99	651,500	1	2,000	....	....	500	$3,339,500
Schools	1	42,000	2	2,100	....	....	....	....	3	44,100
Stores	50	435,000	13	132,500	1	1,500	1	4,000	65	573,000
Theatres	....	....	....	....	....	....	1	15,000	1	15,000
Warehouses	7	330,500	4	175,000	....	....	....	....	11	505,500
Total Buildings	474	$3,928,000	132	$1,662,100	4	$37,500	2	$19,000	612	$5,646,600
Bridges	....	....	6	$ 57,500	....	....	....	....	6	$ 57,500
Dams and Wharves	....	....	1	18,600	....	....	....	....	1	18,600
Sewers and Watermains	7	47,900	4	18,900	....	....	....	....	11	66,800
Roads and Streets	....	....	7	137,100	....	....	....	....	7	137,100
General Engineering	15	2,541,000	2	52,000	....	....	....	....	17	2,593,000
Grand Total	496	$6,516,900	152	$1,946,200	4	$37,500	2	$19,000	654	$8,510,600

Construction Contracts Awarded in Western Canada, February, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 17,000	1	$ 5,200	....	$..........	....	$..........	3	$ 22,200
Churches	1	5,000	1	12,000	....	....	1	20,000	3	37,000
Factories	5	270,000	3	180,000	....	....	....	....	8	450,000
Garages	2	7,500	....	....	....	....	....	....	2	7,500
Hotels and Clubs	2	12,500	1	15,000	....	....	....	....	3	27,500
Office Buildings	2	12,500	3	40,000	....	....	2	90,000	7	142,500
Public Buildings	..	....	....	....	1	25,000	....	....	1	25,000
Residences	120	397,700	21	59,100	3	6,500	8	103,700	152	567,000
Schools	2	8,300	2	20,200	....	....	2	77,000	6	105,500
Stores	15	61,900	4	9,800	1	25,000	4	18,300	24	115,000
Warehouses	4	53,000	....	....	....	....	....	....	4	53,000
Total Buildings	155	$ 845,400	36	$ 341,300	5	$56,500	17	$309,000	213	$1,552,200
Bridges	2	$ 35,000	3	$ 120,000	....	$..........	....	$..........	5	$ 155,000
Dams and Wharves	2	137,000	....	....	....	....	....	....	2	137,000
Sewers & Watermains	3	186,700	2	17,200	....	....	2	45,000	7	248,900
Roads and Streets	....	....	1	9,800	....	....	....	....	1	9,800
General Engineering	3	93,000	1	2,800	....	....	....	....	4	95,800
Grand Total	165	$1,297,100	43	$ 491,100	5	$ 56,500	19	$ 354,000	232	$2,198,700

Contemplated New Construction Work in Canada, February, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 80,500	6	$ 291,000	....	$..........	2	$ 70,000	10	$ 441,500
Churches	22	511,000	8	480,000	2	33,500	10	425,000	42	1,449,500
Factories	14	296,000	2	50,000	1	30,000	5	204,500	22	580,500
Garages	17	450,000	5	162,000	1	5,500	13	137,000	36	754,500
Hospitals	3	160,000	1	30,000	3	272,000	7	860,000	14	1,322,000
Hotels and Clubs	11	416,000	2	50,000	1	30,000	9	456,000	23	952,000
Office Buildings	3	142,500	6	881,000	1	100,000	6	315,000	16	1,438,500
Public Buildings	16	1,472,900	1	200,000	....	....	7	97,600	24	1,770,500
Residences	292	1,640,000	78	505,500	24	118,500	149	788,500	543	3,052,500
Schools	23	1,266,000	29	1,129,000	1	200,000	38	991,700	91	3,586,700
Stores	46	638,000	6	170,000	1	14,000	11	190,500	64	1,012,500
Theatres	1	200,000	2	19,000	1	20,000	3	103,000	7	342,000
Warehouses	6	132,000	....	....	1	10,000	3	75,000	10	217,000
Total Buildings	456	$7,404,900	146	$3,967,500	37	$833,500	263	$4,713,800	902	$16,919,700
Bridges	10	$ 307,100	3	$ 535,000	....	$..........	....	$..........	13	$ 842,100
Dams and Wharves	5	214,000	....	....	....	....	3	457,300	8	671,300
Sewers & Watermains	10	195,000	8	3,160,000	....	....	7	714,000	25	4,069,000
Roads and Streets	126	2,714,000	3	70,000	....	....	1	30,000	130	2,814,000
General Engineering	17	1,406,000	1	200,000	....	....	7	89,100	25	1,695,100
Grand Total	624	$12,241,000	161	$7,932,500	37	$ 833,500	281	$6,004,200	1103	$27,011,200

Construction activity in Canada according to figures compiled by MacLean Building Reports, Limited, during the month of February, amounted to $10,718,300, compared with $17,641,000 in February 1921. The figures for the different Provinces are as follows:—Ontario, 496 projects valued at $6,516,900; Quebec, 152 projects valued at $1,946,200; British Columbia, 165 projects valued at $1,297,100; Nova Scotia, 2 projects valued at $19,000; New Brunswick, 4 projects valued at $37,500; Saskatchewan, 5 projects at $56,500; Manitoba, 19 projects valued at $354,000; Alberta, 143 projects valued at $491,100; total for Dominion, 886 projects valued at $10,718,300.

During February the value of building and engineering work reported for the first time as contemplated reached the impressive total of $27,011,200. This represents cost of 1103 different projects reported by MacLean Building Reports Limited, during February, and serves as a reliable forecast of work to be undertaken in a month or two. The figures are as follows:—Western provinces, 281 projects valued at $6,004,200; Ontario, 624 projects valued at $12,241,000; Quebec, 161 projects valued at $7,932,500; Maritime provinces, 37 projects valued at $833,500. Total 1103 projects worth $27,011,200.

Residential buildings accounted for 37.8% of the February total of contracts awarded and amounted to $4,049,200. Business buildings amounted to $2,539,600 or 23.7% of the total; industrial buildings $610,000 or 5.7%; public works and utilities $3,519,500 or 32.8%. Industrial building, although small, showed a gratifying increase over the previous month.

During January the wholesale price index of 48 building materials receded to a point 6.1% below December 1921 and is now 83.3% above 1913 compared with a peak of 183.8% reached in May, 1920. Prices have now declined 51.9% from the high.

There seems no good reason why we should not witness in 1922, comments MacLean Building Reports, a revival in building construction upon the largest scale since the boom days of 1912 and 1913. Wages have come down in a considerable degree, and

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
February, 1922	$ 6,516,900	$ 1,946,200	$ 56,500	$2,198,700	$10,718,300
February, 1921	5,626,800	11,108,000	304,700	601,500	17,641,000
February, 1920	13,189,000	1,582,300	614,700	2,951,100	18,337,100
February, 1919	3,033,900	14,252,000	1,387,100	1,076,800	19,749,800
2 months, 1922	13,126,100	2,586,800	458,500	2,939,500	19,110,900
2 months, 1921	8,270,400	12,369,200	401.600	5,547,300	26,588,500
2 months, 1920	19,550,500	9,817,500	1,133,700	3,900,900	34,402,600
2 months, 1919	4,033,900	14,394,000	1,647,200	2,659,000	22,734,100

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
February, 1922	$ 4,049,200	$ 2,539,600	$ 610,000	$3,519,500	$10,718,300
February, 1921	2,986,000	10,814,600	1,192,000	2,648,400	17,641,000
February, 1920	2,427,300	4,092,100	8,601,500	3,216,200	18,337,100
February, 1919	1,447,300	1,697,600	8,249,900	8,355,000	19,749,800
2 months, 1922	6,412,900	4,323,200	898,500	7,476,300	19,110,900
2 months, 1921	4,212,500	13,335,400	1,463,000	7,577,600	26,588,500
2 months, 1920	3,810,400	9,880,500	16,894,900	3,816,800	34,402,600
2 months, 1919	2,098,100	2,769,900	8,316,400	9,549,700	22,734,100

labor in the building trades is easy to secure, and, in general more efficient than it has been for several years. Building costs, while still above the level of pre-war times, have gone through a considerable deflation, and it is probable that they will not recede any lower until the edge is taken off demand by a year or two of active building. Money for building purposes will be available in a plentiful supply and interest will probably be lower in the near future. All these factors unite with the great need for housing facilities to bring about a situation which should result in a general resumption of construction.

Labor Union Abuses Eliminated by New Working Rules

Bricklayers', Masons' & Plasterers' International Union of America Subscribe to an Agreement That Recognizes all Legitimate Objects of Unionism, but at the Same Time Does Not Limit the Rights of the Employers and the Public

An agreement has been drawn and signed in Washington, during the past week, establishing new working rules, with approximately 120,000 members of the Bricklayers' & Masons' & Plasterers' International Union of America. These few rules are directly opposed to many of the rules of the American Federation of Labor, which was not consulted in making the agreement. The government had taken action in the form of a threat of prosecution, with the possible indictment and imprisonment of those engaging in conspiracies to curtail production, to force demands on questionable claims, to prevent the full measure of service on the part of workmen, to attack those out of favor with the union, to order that supplies be purchased from favored firms, and so on. As a result of this, government representatives of the union indicated the unions to accept a settlement of the differences. As finally accepted, the agreement, or decree, as it is called because it will be entered in the U. S. Court in New York within a few days, provides briefly as follows:

1—There is to be no limit to the productive capacity of the individual workman within the working day or any other time.

3—There is to be no limit upon the right of the employers to purchase their material wherever and whenever and from whomever they may choose, whether these moterials be union-made or otherwise.

3—There is to be no favoritism shown by organized labor toward employer or trade associations and no discriminations are to be indulged in against the independent employer who may not be a member of such an organization.

4—The labor organization is not to be used, or permit itself to be used, by material men or contractors or subcontractors as an instrument for the collection of debts or enforcement of alleged claims.

Various points considered in the above sections are explained more fully as follows:

"The first section, providing that there shall be no limitation to a man's productive capacity, is more or less an outgrowth of the cost-plus system which prevailed during the war period. Various local unions of this and other labor organizations have from time to time practically and often openly limited their men in the quantity of the work to be performed by them within a given time. Some locals have enforced the rule that a bricklayer must lay only so many bricks an hour, or a mason set only a certain quantity of stones a day, and so on down the line. It is gratifying to note that the executive heads of this national labor organization have for many years condemned this practice. It is a heritage of the war period, when unscrupulous contractors, operating under the cost-plus system, were perfectly content to have fifty men on a job where half or one-quarter of the number could do the work. Labor has for years contended that it is not a commodity and not to be regarded as a commodity.

"That principle has been and is now incorporated in the basic law and is recognized and expressed in the first sentence of the Clayton law. In line with that principle, a laborer is a human being and human beings are capable of different and individual productive capacity in time, quantity and quality of work.

"The ambitious workman must be given a full and ample opportunity. He must not be reduced to the level of his most inferior co-workers. This decree in spirit is in hearty sympathy with all the laudable aims and ambitions and with the progress which has been made by labor unions. It is directed against the abuse that has inevitably grown up. Nothing in the decree prohibits the regulation of the hours or the conditions of labor. It does, however, unqualifiedly forbid any concerted effort of curtailment of production by any such limitations upon the productive capacity of the individual. In a word, it eliminates the penalizing of ability and the discouragement of efficiency."

The explanation of the other three points in the decree follows:

"The second is directed against the various discriminations which have been indulged in by labor organizations engaged in the building trade, whereby they sought to restrict a builder from puchasing and importing the finished material from the sources of their production. By way of example, for many years a rule has prevailed that stone could not be set by members of this union if an employer or builder bought stone finished and dressed at the quarry and imported it to the place where it was to be used in construction work. In other words, in case of construction work in all of the larger cities of the land the labor union required that the stone be imported in the rough and dressed and finished locally by union labor.

"In addition to that, various other restrictions have been imposed by labor organization, not only upon materials that were non-union made, but likewise even though such materials were union made, which restrictions sought to dictate to the builders the source and the locality from which he shall purchase his materials.

High Cost of Building

"The effect upon the community of any such restrictions can be readily imagined. They constitute undoubtedly one of the most potent factors for the high cost of building, the consequent shortage of housing and the enormous increases in rent that have obtained during and since the war period. Since the decision in the Duplex case and other similar cases, any such restrictions are clearly illegal. They constitute a stumbling block in the path of interstate trade and commerce.

"The third is directed against a series of nationwide abuses which have assumed various forms and aspects in the relations between organized labor and trade associations. Innumerable instances have been found in the various building trades where in consideration of some bonus or other inducement offered to the labor organization, the labor would in turn agree to grant a preference or to furnish some co-operation to the trade association member as against his independent competitor.

"Take the case that arose recently in the New York District by way of example. An individual had several millions of dollars available for the erection of four hundred modern modest homes which he was then planning right in the vicinity of New York. He was not a member of the Tile Contractors' Association. Under the agreement, however, that then prevailed between the Contractors' Association and a local office labor organization the materials had to be purchased from the same contractor who supplied the labor.

Restrictions By the Union

"This builder found himself in a position, therefore, that he could not secure the necessary labor if he made any attempt to purchase his tile other than as directed under the terms of this agreement. If he attempted to buy his tile directly from the original manufacturer at a reduced price of probably 60 to 100 per cent, the penalty would be that the local labor organization would refuse to set any such tile. As a result the four hundred homes were never built. Labor itself suffered the real loss, not only by not being employed but by not having the model homes which it was the intention of the capitalist to build.

" These general practices of preferences and special agreements made for the benefit of contractors' associations have grown into a veritable national system in the building trades. The inevitable effect was not only to eliminate all competition in the field involved but of necessity to increase the number of unemployed and to create an unlimited monopoly in the hands of these trade associations. An independent dealer in any one of these building trades found it an impossible task to develop his business because these associations had first and often times exclusive call upon the local unions. It is manifest that such a state of affairs is likewise one of the most potent factors in the exorbitant prices that have prevailed in building and related material, all of which have tended to create and continue the acute shortage of housing in every large city in the land.

Unions as Debt Collectors

"The fourth strikes at what has likewise become a general practice, viz; contractors and builders using labor unions as instruments for the collection of their debts. Instances have been reported to the department from both Chicago and New York, and no doubt the practice prevails in the other large cities, where the labor unions refused to work on the completion of a job where they had been compensated fully and had every assurance of future compensation only because some previous owner of the same building had defaulted in a payment to some material man. Oftentimes it was shown that the exaction and demand of the material man were unfounded.

Frees Employer From Shackles

"In conclusion it may be fairly said that this decree incorporates a set of principles which make for independence on the part of the employer in the purchase of his materials whenever and wherever he may desire. It frees the employer from the shackles that have been thrown around him by these numerous illegal restrictions as to the quantity of work to be done in a given time irrespective of whether his materials are or are not union made. On the other hand, it recognizes all the lawful aims or objects of labor unionism.

"It gives the individual members of the labor union an opportunity to put forth the best that is in them in the particular work that they may be doing and to give full swing to the full development of their individual capacity and ambition. Finally, and the most important, it gives the public a chance. In a sentence, this decree constitutes a new Bill of Rights for the home builder, the rent payer, the manufacturer and the business man who has to build."

Highway Drainage and the Application of the Drainage Laws

Proper Methods of Keeping Water Away from the Roads—Procedure in Instituting Drainage Schemes Under the Drainage Legislation of Ontario

By U. W. CHRISTIE
County Engineer, Dufferin County, Ont.

Before Conference of County Road Superintendents and Engineers of Ontario

Drainage besides carrying off the surface water from the road reduces the water content of the subgrade and improves the foundation. Road failures have largely been the result of weak foundations at the time frost is coming out of the ground, when the water content of the soil is high and foundations are consequently weakened. If we except the telford and probably some other large stone sub-base types of road, foundations have not been built with large enough interstices to resist capillarity. Hence the water level must be lowered an amount to overcome capillary action; just how much depends upon the character of the subsoil. In light soils the water rises rapidly and falls rapidly; in heavy soils it rises more slowly and falls more slowly. In light soils the percentage of water in the soil decreases rapidly with the height above the source, while in some heavy soils the water content is strikingly uniform at different depths.

Horizontal capillarity occurs with much faster water movement and greater uniformity of moisture content. The speed and distance vary with the different soils and range from 7 to 33 feet in the first 24 hours. The rapidity with which capillary action occurs when there is a free source of water makes it necessary to remove this source with the greatest promptness if a substantial road foundation is to be maintained.

If it is absolutely necessary to allow water to stand or flow along a road for even a few hours, the height of the subgrade above the surfaceof the water and its distance horizontally from the water source must be considered. For water on the side of a road for one day at a time, we would require a height of subgrade of about 18 inches and if the horizontal distance was large we might reduce this; but if the road were beside a pond or lake or any body of water that remained for a considerable time, the height of subgrade above the surface of the water would have to be increased to a height of 3 or 4 feet.

Frequent Discharge of Water

In grading the practice has been to excavate from the sides of the road to raise and form the grade. If these trenches have not a continual fall to outlets where water will run freely away, they are not drains but elongated ponds which hold the water and permit it to soak into and soften the roadway. Water must be made to flow from the road as quickly as possible. Trenches should not be carried along the side of the road and past outlets as has frequently been done but water should be discharged in small quantities into frequent outlets.

Culverts should be so placed that water carried across the road will be carried off the road directly from the culvert.

Tile drains should be made use of to carry water away from all springy or soft spots in the foundation and to intercept water likely to reach the foundation. A tile drain should always be placed on the higher side of a side hill road, if there are indications of water trouble and often on the face of a hill. In the latter case the drain may be in the centre or to one side of the road. Tile drains should be about 3 feet deep, should be laid carefully to grade and should be covered with an open material such as gravel, crushed shone or cinders. If in quicksand the tile should laid on boards and cinders should be used in preference to gravel and stone.

Where a tile drain is required to carry off surface water, it should be at least 6 inches in diameter and for this purpose ordinary porous field tile are not suitable, but the tile should be concrete or vitrified pipe with bell and spigot ends or some other form of joint and each pipe should have a laying length of 2 feet. The surface water should enter through catchbasins, the floors of which should be 2 feet below the invert of the pipe. A cheap way of building these is to place 24 inch diameter pipes in a vertical column and place 4 inches of concrete in the bottom and a cast grid on top. Catchbasins should be cleaned out frequently to insure the tiles remaining open.

Obstructions that will impede the free flow of water should be removed from culverts and drains at frequent intervals and a special effort should be made each fall to see that this is done and also to see that fences are removed from all drains.

Legislation Affecting Drainage

In most county road drainage problems, other roads and lands are effected and the machinery for initiating, carrying out and distributing the cost of these is provided for in our Ontario drainage acts of which there are two, the Ditches and Watercourses Act and the Municipal Drainage Act. The former is for the smaller undertakings and for forcing an outlet, and the latter for the larger undertakings.

Work that may be undertaken under the Ditches and Watercourses Act is limited to a cost of $1500 and to a length of 7 township lots. The land, the owners of which may be made liable for the construction, is that laying within 150 rods of the sides and upper end of the drain.

The owner of higher lands has not the right to construct the drain to dump water on lower lands and if such a drain be constructed the owner of such lower lying lands may block up or dam such a drain. In fact the owner of the low lying lands may block back a surface flow of water, but not a natural watercourse. Drainage may only be undertaken by agreement of owners or by the legal application of the drainage laws.

Procedure Under Ditches and Watercourses Act

A party requiring an outlet and wishing to proceed under the Ditches and Watercourses Act would proceed as follows.—

He would file with the clerk a declaration of ownership, and would obtain from him a form of "Notice to Owners of Land Affected by the Proposed Ditch" and also a form of "Agreement of Owners". The notice of owners he would fill out sign and serve personally, or leave with a grown-up person at the usual place of abode of the owner or occupant; in the case of a non-resident he would serve the notice upon the agent of the owner or send by registered post to the post office nearest the place of his last known residence, and where his place of residence is not known, then notice may be served as directed by the judge. The notice should name a day and hour and also a place convenient to the proposed ditch at which the owners are to meet and if possible come to an agreement as to the apportionment of the work and supply of material for construction. The time between the serving of the notice and the calling of the meeting shall be at least two clear days, the day of serving and the day of the meeting do not count. Parties notified have five clear days after service to apply to the county judge to set aside proceedings on the ground that the person commencing proceedings is not an owner within the meaning of the Act. If no such application is made and is not successful the ownership is thereafter not open to question.

If an agreement is arrived at it shall be reduced to writing and filed with the clerk within six days after the signing thereof. Should two or more municipalities be affected the agreement shall be in duplicate or triplicate, etc., and one copy shall be filed with the clerk of each municipality.

Should it happen at the meeting of owners that notices were omitted or improperly served the owners present may adjourn the meeting to a subsequent date to allow the notices to be properly served. The head of any municipality may sign the agreement as owner.

If an agreement is not arrived at by the owners at the meeting or within five days thereafter, the owner requiring the ditch may file with the clerk of the municipality a requisition, naming therein all the lands that will be affected and the respective owners thereof, requesting the engineer to appoint a time and place at which he will attend to examine the premises, parties and their witnesses, if any.

The clerk shall notify the engineer, who will in return notify the clerk of the time and place at which he will attend. The clerk files the copy of the appointment of attendance of engineer and sends one copy by registered mail to the party making the requisition, who shall, at least 4 clear days before the time appointed, serve notice upon the other owners requiring their attendance. After the service of these notices the party shall indorse on one copy the time and manner of service and leave with the engineer at least the day before the date fixed in the notice of appointment.

The engineer will attend at the time and place, examine the premises and if he considers a ditch necessary will lay it out. In due time he will file his award with the clerk, who shall notify each of the persons affected within the municipality by registered letter or personal service, of the part of work to be done and material to be furnished by each person.

Appeals From the Award

Any owner affected by the award may within 15 days of the notice of the filing of the award appeal therefrom to the judge. The appellant shall serve upon the clerk of the initiating municipality a notice in writing of his intention to appeal, shortly setting forth the grounds of appeal. The clerk will notify the judge of the appeals and will furnish him with a copy of the award. The judge will fix a time and place to hear the appeal at which he may set aside, amend or affirm the award. The order of the judge shall be filed with the clerk and the award as altered or affirmed, may be enforced in the same manner as the award of the engineer.

If the drain be not completed at the time specified in the award, the engineer may let the work and the supply of material to the lowest bidder and the cost shall be borne by the parties failing to comply with the award.

The drain shall be maintained by the parties whose lands have been awarded maintenance, and any owner who fails to do so may be notified in writing by any other party to the award to have his portion put in repair within 30 days from the receipt of such notice; and if the repairs are not made and completed within 30 days, the owner giving notice may notify the engineer in writing, to inspect the portion complained of. The costs of enforcing maintenance are collected in the same way as costs of construction.

The Municipal Drainage Act

Under the Municipal Drainage Act, new work must be undertaken by a petition, which must be signed by a majority in number of the resident and non-resident persons, exclusive of farmers' sons and others not actual owners, as shown by the last revised assessment roll to be the owners of the lands to be benefited in any area described in such petition within any township, incorporated village, town or city, to the municipal council thereof, for the drainage of the area described in the petition.

The council procures an engineer or Ontario land surveyor to make a report which would include an estimate and recommend an assessment on the owners of lands and roads. Upon the filing of the engineer's report with the clerk of the municipality, the clerk shall notify the parties assessed of such assessment and the amount thereof, and the date of the council meeting at which the report will be considered.

The engineer's report shall be of as many copies as there are municipalities affected and the initiating municipality shall notify each other municipality.

At the meeting for considering the report, the clerk shall read the report to all the ratepayers in attendance and an opportunity shall be given to any person who has signed the petition to withdraw in writing and an opportunity shall be given to persons who have not signed, to do so. Should the petition at the close of the meeting contain the names of the majority of owners, the council may proceed to adopt the report and pass a by-law authorizing the work, but if after striking out the names of the persons withdrawing, the names remaining including those added do not represent the majority of owners according to section 3 of the act, then the persons who have withdrawn from the petition shall on their respective assessment on the report, with 100% added thereto, together with the other original petitioners, be pro ratio liable to the municipality for all expenses incurred.

For repairing drains constructed under the act it is not necessary to have a petition. A simple resolution of council is all that is required and anyone having a grievance owing to the non-repair of a drain simply makes application to his council, whose duty it is to have repairs made.

In the case of reports by an engineer for a new drain under sections of the act, where the assessments are varied from their original proportions, there are appeals.

(1) By individuals.
  (a) To the court of revision.
  (b) To the county judge.
  (c) In certain cases to the drainage referees.
(2) By municipalities in case two or more municipalities be affected.
  (a) To the drainage referee.
  (b) To the high court.

The Use of the Sand Blast in the Maintenance of Steel Structures

Mill Scale and Rust Most Effectively Removed by Sand Blasting which Reaches Every Crevice and Cleans Parts that Cannot be Cleaned by Other Means

By F. R. THOURET
Canadian Sand Blast Co., Ltd.

At this time of the year engineers of the governments, municipalities and railways are preparing to put into execution their construction and maintenance programmes for the summer of 1922. The building of new bridges and the reconstruction or maintenance of the old ones is one of the problems requiring the best experience, foresight and consideration from an engineering and economic standpoint.

With increasing loads on both railways and highways many existing steel bridges which have given good service for years are now inadequate and should be replaced. Yet in many cases, in view of financial stringency, it is impossible to build new structures at once. It may be admitted that the whole question of the maintenance of steel in such structures deserves greater attention than has often been given to it. Steel is an ideal structural material, inasmuch as it is strong and most reliable and, if properly protected, very enduring. But it must be protected from corrosion.

Mill scale and adverse weather conditions promote corrosion. Mill scale and all rust must be removed before any paint is applied. The first coat of paint is designed to protect the clean steel surface. The second coat of paint protects the first coat from the weather and this second coat must, therefore, be impervious to moisture and frost.

On old structures, whether bridges, water towers, or other forms of exposed steelwork, we think it pays well to remove old paint, rust scale and mill scale, by every known means, and the most modern, thorough and far reaching means is the sand blast in the hands of a skilled operator.

Sand blasting as applied to the cleaning of steel is an idea of recent origin and has become popular with engineers everywhere. This popularity is based on results obtained, as a careful perusal of the following facts will show.

In order to accomplish the best results an air compressor of sufficient size to furnish plenty of air for all classes of work must be used. As the pressure and cubic feet of air required vary according to the material to be cut, it is essential that the compressor be equipped with the necessary devices for control of air delivered to the mixer. After the air is delivered to the receiver, it is conducted by pipes and hose to the mixer where the air picks up the sand and discharges it through a special hose and nozzle at any pressure or force desired by the operator.

This, in as few words as possible, is an explanation of the whole scheme of sand blasting. There are, of course, a great many details in connection with the above work, i.e., the right pressure used on steel, stone or brick; elimination of water from air; kinds of sand to use; atmospheric conditions. There are a thousand and one details to watch, but as these are the concern of the operator, we shall not enumerate them here.

In sand blasting steel, it is necessary to maintain a high and even pressure, as a low pressure will not cut off rust and scale entirely. When a high pressure is used, the rust and scale disappear and the steel is polished like dull silver. No attempt is made to cut off paint which is in good condition or which adheres firmly to the steel.

The blast is first passed over the surface to be cleaned and the force with which it strikes the steel immediately reveals all bad spots, lifting blisters, knocking off scale and removing rust. Once these are revealed it is only necessary to polish the blemishes, and the steel is ready for the paint.

That the sand blast will reach every point, pocket or crevice is obvious, and a lattice girder or cross bracing cannot be cleaned in any other way. The thorough manner in which the work has to be done cannot be slighted as the first touch of the blast shows the condition of the steel. In using scrapers or brushes, it is usually impossible to reach the places most affected by the weather and even the parts which are readily accessible cannot be cleaned by brushes or scrapers. To apply paint to a steel structure which has not been well and thoroughly cleaned, is worse than folly, it is wilful waste of labor, time and paint.

Generally the cost of blasting and painting is higher than scraping and painting but the long life of the paint after blasting really makes it the cheapest process in the end.

Establishing a Proper Balance in the Construction Industry

Co-operation the Keynote in the Work of Reconstruction—Obtaining the Public's Confidence—Readjustments of Costs— Stabilizing Industrial Conditions by Means of Construction—Training of Mechanics—Industrial Relations

By ERNEST T. TRIGG
President, National Federation of Construction Industries

Before the National Association of Builder's Exchanges, at Memphis, Tenn.

It is likely that there was never a period during times of peace, when co-operation of all the people was more needed than now. Contractors, artisans, bankers, railroad men, miners, farmers, women—indeed everybody—must join in unselfish, helpful, friendly, and intelligent co-operative effort, and maintain a magnanimous spirit one toward another, if we are to obtain for our country the prosperity and internal peace which should be the goal of all.

This is particularly true of those connected with the construction industry. The condition of this industry, and particularly the building branch, has probably larger and more potent possibilities of influence upon the business and industry of the country as a whole, than any other division of productive activity. It represents, next to agriculture, the greatest classification of industrial activity in the country, and is the industry through which the permanent wealth of the country is largely created.

We are now in progress of endeavoring to re-establish a proper balance in construction, and to readjust prices and production to points where construction may be renewed economically in sufficiently great volume not only to supply the normal needs of the people, but to make up the shortages caused by the unbalanced activities of the past few years. This is a large project, and only through co-operation and by all working harmoniously together can it be carried through properly.

But in the great work of reconstruction it would be unwise for us to aim merely at a return to pre-war activities. There have been various undesirable influences at work for a score or more of years which in many cases, have been intensified by the war, and certain unsatisfactory conditions and practices have been permitted to continue with little or no change to the present time. It is a few of the problems caused by these influences and conditions, and of the kind of co-operation that seems essential for their solution, that I refer to herewith.

Confidence of the Public

One thing seems very evident—that before we can look for a permanent revival of construction activities we must, as an industry, justify to the public a full confidence in values, and that means to a large degree, that we must earn and be entitled to their confidence in our practices and in our performance. Unfortunately, perhaps due in a measure to the nature of the construction industry, there have been in the past in some instances, aggravated examples of collusion resulting in unnecessary delays and expenses, which the public has had to pay for. We can never hope to enjoy that full warranted confidence of the public until all wrong, unfair and unnecessary acts on the part of any branch of the industry are eliminated and we deal with the public in an earnest, honorable, open way and give them full value for their money invested.

I do not believe that the practices which fair-minded men in the industry condemn, have been general because I do believe that the great majority of persons, including labor, actively and directly engaged in the construction industry, are just as honorable and fair as are the men in any other line of activity. It is, once more, a case of the actions of a few selfish and narrow visioned men who have, for their own immediate and temporary gain, brought more or less general disrepute on an entire industry.

House Building

In the matter of home-building, of which there is such a great shortage, we know that since the signing of the armistice there has not been a general return of activity because prospective buyers have not had sufficient confidence in the stability of values. There are three outstanding elements entering into the cost of constructing a home. I refer to the cost of such financing as is required; to the cost of materials, and to the cost of labor. Fortunately, the cost of getting the money necessary is, to-day, on a reasonable basis and speaking generally, home-building can be financed without exorbitant charges. Many material costs have been reduced to a reasonable level, in some instances below the cost of replacement. Other building materials are still high and the manufacturers of such materials will sooner or later be obliged to realize that they are not only retarding their own activities but that they are holding back business possibilities on the part of other building material manufacturers who have reduced their prices, and that they are keeping engineers, architects, contractors and labor from useful occupation, and adding materially to our national unemployment problem.

Labor in some centres has been wise enough to accept reasonable reductions but so far as the building trades are concerned I do not think this is generally true. I am not an advocate of hiring labor at the lowest figure to which it can be driven. I believe that labor should receive a compensation sufficient not only to take care of the necessities of life, but to enable the family to provide proper education for the children, to enjoy some of the comforts of the modern day and to have a little left for systematic saving. I have advocated this for over a year and have yet to find a contradiction of the righteousness of this basis, from any reliable source. In considering the building trades, specifically, it must be remembered that employment is not of the continuous, all-year-round, every-day-in-the-week nature that exists in other industries. As average of perhaps four days a week is not, at least, an over-statement. In the readjustment of wages in the building trades, I feel that the rates paid to so-called common labor should more closely approach the rates paid to skilled labor than in the past. We all remember how prior to the war common labor oftentimes was paid as low as 17½ cents an hour and in some communities even less. On the basis of a ten-hour day and four days a week, this meant that many a husband and father went home to his wife and growing family with only $7.00 in his pocket to cover 7 days' expenses. We can all realize what this means and it is very much to be desired in my opinion, that we do not permit the wage of common labor in the building trades to again come down to the low point of the past.

On the other side of this question we are now confronted with organized groups of working men in some localities, who, it is stated by their leaders, refuse to accept a reduction in their wages from the peak rates of 1920. This sort of a policy cannot prevail eventually and adherence to it simply means a delay in the inevitable readjustment and means not only unnecessary continued stagnation in building activities where it exists, but means great suffering and a great economic loss to everyone involved. I have faith in the fairness and in the good, common-sense of the great majority of our working men and I hope that the time is not far distant when this good, common-sense is going to assert itself in the communities not yet readjusted, to the end that labor may do its part to encourage the return of confidence in the building trades as a whole and a return of genuine and permanent activity.

Seasonal Occupation

The building trades have always been and always will be, to a marked extent, dependent upon the weather and of a seasonal character. It is evident, however, that careful attention to the subject should make it possible to lengthen the season of actual construction, and thus eliminate a waste of labor which is a serious loss to the country as a whole, and works a hardship upon the building artisan. In most parts of the country, labor agreements up to this year, were made in the late spring. This threw the settling of wages for the season well into the period during which construction can be carried on, and far after the time when it is frequently well to let contracts. The setting of wages at this time made the preparation of estimates of costs for bids difficult, and did much to throw construction back. Near the beginning of 1921, the Industrial Relations Committee, of the Philadelphia Chamber of Commerce—a self supporting body created to promote better relations and conditions in industry and to aid in reviving prosperity—appreciating the importance of obtaining helpful community co-operation among all affected, held a four days' conference of employers, labor, material men, bankers, transportation men, and others who could be of service. Largely as a result of this meeting, the construction industry in Philadelphia, in addition to establishing a reasonable adjustment of wages, obtaining some deflation in prices of materials, and developing methods for obtaining more normal production, also set the first of the year as the date, hereafter, when wage adjustments are to be made in that city. Incidentally, I should add that the beneficial results of this town construction meeting were so pronounced that the National Federation of Construction Industries called a national conference, and has since inspired many community conferences of similar nature.

The new date for wage adjustments makes it possible to plan for construction in January with reasonable assurance as to the labor costs which will be involved during the current year, and thus enables materials to be prepared and delivered during the winter, and construction to begin at the earliest date the weather permits.

Lengthening the Working Season

It seems also possible by proper planning, to more fully arrange for the prosecution of work which can be done under cover in the cold weather than is current practice, and in other ways to lengthen the average worker's days of labor for a year. It should be added, in this connection, that any methods which will forward the amount of construction work let in the fall or early winter, will be of material advantage in stabilizing all industry, by reason of the fact that the making of contracts at such times will tend to keep the supply and materials establishments busy through the winter, and to even up the load upon the transportation systems. Normally, it is possible under early contracts to obtain lower prices for materials, and it would not seem unwise for the transportation companies to make seasonal rates which would encourage winter and early spring deliveries. For the accomplishment of improvements of this kind it is evident that there must be effective community as well as national co-operation.

Construction as a Stabilizer

We find that during each of our past war periods prices arose to tremendous heights, the increase in each period being practically the same and that between these peaks, we had a period of declining prices running for twenty to twenty-five years, and then a period of twenty to twenty-five years of steadily advancing prices, back up to the peak. Through these cycles there were, of course, interruptions, but in the main the tendencies were downward to the low point and then upward to the high. If history repeats itself again, then we are facing a declining market for some years to come. I wonder if this does not have in it an immediate lesson for all of us?

Are the rules of the business game during a long downward cycle just the same as the rules when the reverse is true? I think not. One particular condition especially I wish to refer to: When prices are in the main advancing, the buyer does not need to exercise the same great care in buying. If he happens to pay a little more than the market or buys more than he needs, his carrying charges from one inventory to another, or his loss on apparent disadvantage because of paying a little more than the market, is taken care of by advances which are sure to come. In a declining market the reverse is the case The longer the buyer holds goods for which he paid too much, or stock he cannot turn over promptly, the greater is his loss. This, it seems to me, makes absolutely sure greater buying resistance on the part of buyers generally and requires sound and more able salesmanship to secure the business of the buyer.

Stabilizing Industrial Conditions

The problem of stabilizing industrial conditions in a way which will prevent excessively acute periods of prosperity and depression such as we have been experiencing, is more complicated and difficult than that of dealing with seasonal changes, and is more distinctly a problem for national co-operative action.

There are many who believe that construction can be used to advantage as a form of stabilizer. It is thought by promoting public and private works actively when periods of acute depression are approaching and slowing them down with the approach of excessive prosperity, that a balance wheel of no mean proportions can be introduced which will tend to reduce the severity of either of these undesirable extremes.

The use of public works for this purpose has been given a good deal of attention in this country and in Europe and has been applied with some degree of success. Certain of our very large public service corporations, which are compelled to do much construction work, have already inaugurated plans under which it is intended that their construction shall be slowed down during prosperous times and speeded up during depressed times. It is understood that this policy on the part of corporations is being developed not only for the purpose of steadying business in general, but with the more concrete aim of taking advantage of the low prices that usually exist in depressed times and avoiding the high prices that usually exist when business is exceptionally active. Does there not seem to be the seed of possible useful development as a result of movements in this direction? Whatever the answer, the problem is a complex one and demands unity of purpose on the part of all affected for its intelligent consideration.

Skilled Workmen

Some generations ago the building mechanic was, as a regular practice, a graduate of an apprenticeship course. It is possible that in many cases he was given so little mental drill and such narrow training as to have prevented his becoming as skillful and capable as desirable. On the other hand, he went through a training period of approximately four years and undoubtedly obtained, as a rule, much sound preparation for his trade. I doubt much the desirability of a return to the specific type of apprenticeship courses of those days, but, nevertheless, it seems apparent that facilities for the specific training for our building artisans are at present so meagre as to make action essential as a matter of business economy.

One of the largest contractors and engineers in the country not long ago stated that the average mechanic whom he employed had obtained his trade training by picking it up through chance opportunities, and that not uncommonly such mechanics were but little removed from the "hatchet variety." School authorities who have made extended investigation state that a large proportion of our young people who leave school from the grades, and who are capable of becoming highly skilled workers, float about without definite direction and locate in various trades or labor without adequate preparation for their work.

Some of the industries of the country, notably the typothetae, the merchant tailors, and a long list of the best managed of our great manufacturing establishments, have taken up this subject and are now carrying on, frequently at their own expense, schools of high type for preparing workers for their specific requirements. If these establishments find it practical to do this, should not the building trades, which demand mechanics of the highest type for much of their work, take steps in the same direction? The nature of the building business renders it largely impossible for single contractors to handle projects of this kind, but it does look as though proper co-operation on the part of the construction interests in the various communities of the country would accomplish much. The threatened shortage of building artisans is another warrant for early consideration of this problem. That there is a very real danger of such a shortage is illustrated by the conditions caused in Brooklyn by an increase of business, where plasterers during last fall demanded and obtained, on account of the shortage of workers, wages of eighteen dollars a day.

Industrial Relationships

The greatest problem of to-day having to do with the revival of business and its maintenance on a permanently sound foundation, is undoubtedly the accomplishment of a readjustment of the relationships and contacts between employers and employees. As a preface to what I want to say on the subject of industrial relations, let me quote from a pamphlet entitled: "The Future of Prices and Wages", being extracts from a study entitled "Price Changes and Business Prospects," by Leonard P. Ayres, vice-president of the Cleveland Trust Company:—

Weekly Wages For 100 Years

One Hundred years ago, in 1820, the average weekly wage of the artisans was about $7.00. This rose steadily during the next 40 years until it was about $10 a week in 1860, just before the outbreak of the Civil War. During the course of that struggle these wages rose from the $10 level to $15 and then kept rising until 1869, or four years after the close of the War, when they passed $17. Then came 10 years of decline until 1879, when they were $14.74. A slight recovery lifted them just above $15 where they stayed for 20 years, or until 1900. They then rose for 15 years, or until 1915, when they amounted to $21.38, and shot up for five years during the World War, and for two years after its close, to an average of $42 in 1920.

During this entire period of 100 years the course of the wages of common labor ran along nearly parallel to that of the artisans and throughout the century their relationship to each other is such that the artisan wage is almost always about 180 per cent of the common labor wage.

Price Changes and Wage Changes After the Civil War

As compared with the changes in wholesale prices, the variations in wages came tardily and moderately. This, however, is not a sufficient explanation of the marked differences between the great changes in prices in the half century following the Civil War, and the comparatively moderate changes in wages. From 1870 to 1896 prices fell 55 per cent. while artisans' wages declined only 9 per cent. From that date to 1915 wholesale prices rose 51 per cent. and wages only 38 per cent.

It is worth while to consider how such great differences were possible, since in large measure the workers that produce the commodities constitute the consuming public that purchases them. This means that there must always be a general balance between wages and prices and yet the figures make it look as though such a balance had not existed.

Most of the explanation is to be found in the revolutionary changes that took place in industry during that half century and greatly increased its productive capacity. The Civil War ushered in the modern era of great industries. Before that time there were few factories in the modern sense of the term and much manufacturing work was still done in the homes of the people. The Civil War brought the beginnings of quantity production. It was followed by important inventions and the introduction of large units of power. Then came factories, automatic and semi-automatic machinery, electricity and high speed steel. These advances in production enabled each worker to produce each day more than he had formerly and, since his productivity was greater, his wages did not need to decline in proportion to the prices of commodities. His share in the output increased, and his standard of living rose.

What of the Future?

The question as to whether or not we are to see wages shrink far less than prices in the next few years is largely a question of what happens to the efficiency and productivity of industry. If improvements in processes and in management can largely increase the output per worker per day, then wages will not have to decline so far as prices.

A Complex Problem

The construction industry presents an unsually complex problem, because the contractor, as a rule, maintains only a skeleton permanent force, while the bulk of the employees under his direction rapidly change in personnel. Under these conditions it is a matter of supreme difficulty for a single employer to build up the substantial and reliable forms of contact between himself and his workers which are to be found in many of our best-managed and controlled industrial establishments having plants in fixed locations and carrying on a more or less continuous operation.

The problem is, however, in many respects, one for community co-operation. I feel strongly that each community should have a committee of employers, engineers, architects, and others, to which is delegated the specific problem of endeavoring to develop plans under which the investor, the architect and engineer, the employer, and the workman, may safely join in agreements that there shall be no stoppage of work in the nature of strikes or lockouts as methods of settling differences, and that there shall be no discrimination in employment as between union and non-union men. An integral and co-ordinate part of the committee's work would be to endeavor to set forth means whereby justice and fair dealing will prevail in a way to protect those who have entered into such agreements.

There is reason for the expectation that methods may be developed through these means which will, at least in a measure, eliminate the enormous costs, to all affected, of artificial stoppage of work through labor troubles; reduce the antagonisms and lack of loyalty which so often exist in the construction industries, and replace the latter by goodwill and frank understanding between employers and employees. Is there not reason to believe that if this subject is entered into with a distinctly co-operative spirit, and with intelligence, by a community, the results will be worth while? Certainly the best interests of employers and employees as well as the public will be conserved if success is attained in this direction.

Employers Should be the Leaders

It is undoubtedly the case that employers should be the leaders in any movements of this kind, since the employer in most cases earned his leadership through his ability, aggressiveness, and wisdom, and more particularly for the reason that only when he has full and loyal co-operation from those under his command can he expect to give economical service. As a rule, employers are inclined to be conservative. They have been taught conservatism in the hard school of experience, but nevertheless, if conditions are not satisfactory in the relationships between themselves and their employees, they must take the greater part of the blame. Had they given sufficient attention and care to obtain the goodwill, loyalty, and productiveness of which most of their employees are capable, the agitator would have little opportunity to cause disturbances.

Strikes and labor disputes have been one of the most fruitful causes of waste in industry. It has been estimated by what is believed to be competent authority, that the loss in America from wages alone, due to strikes, has amounted to somewhere in the neighborhood of a billion dollars in the last forty years, that nine-tenths of this loss has occurred in unionized activities, where the employees paid heavy organization expenses, and that the larger part has occurred in recent times. But probably greater and more vital loss has occurred on account of the bitterness and lack of harmony in industry resulting from these warlike struggles. The enormous losses from strikes fall with heavy severity upon both employers and employees, and also upon the public. Their elimination by the adoption of reasonable and peaceful methods of settling differences is, therefore, a necessary effort on the part of all of us.

Responsibility to the Law

Unincorporated or unchartered bodies are not as a rule liable to damages under the law. This not uncommonly has enabled groups of people to largely evade the consequences of violation of the law under cover of lack of legal incorporation. There seems to be every reason, under the principles upon which our government has been founded, that all organized groups should be held equally liable to damages, irrespective of incorporation or chartering. Thus, it is logical to consider that an organized union of workers should, as an organization, be as carefully bound by legal requirements as is a corporation of investors. The accomplishment of such equality under the law, it is believed, would be of material service in preventing many of the impediments to orderly industrial procedure. Under such a law the labor unions involved in a jurisdictional strike, a sympathetic strike, or other breaches of contract, would be held fully responsible as organizations for their acts.

With this equality of responsibility of organized groups to the law, would it not be well also to have specific laws which would make those who take part in breaches of contract—whether individuals or groups—in the form of strikes or lockouts, or in fomenting them in any way, specifically subject to damages? The interpretations of the courts have already, to a large extent, provided for this, but all lack of clearness might readily be swept away by positive legislative enactment.

An Age of Peace, Goodwill and Prosperity

One of the great outstanding accomplishments of humanity, which will go down into history as possibly the most important event of our times has been the work of the Conference for the Limitation of Armaments, just closed—a great international work of co-operation devoted not simply to the material matter of building a few less warships or fortifications, but to the enormously greater project of creating a permanent state of peace and friendship among nations. The natural complement of this great work is the development of humane and peaceful relationships of goodwill in industry. We are all inextricably inter-related in the complex industrial society of which we are a part; the action of one affects many; failure on the part of the building industry to size up to the proper industrial relationships—some of which I have referred to—will hold back all industry, while, on the contrary, success in these regards by the builders will probably do more to influence and point out the right road to all than could be accomplished in any other way. The right kind of co-operation will enable us to bear properly this vital burden of responsibility, which has been forced upon us by the nature of our business, and only through co-operative efforts can we hope for revived prosperity in either the building industry or the country as a whole.

Early Preparation of Road Programs

County Highway Work Should be Prosecuted in Accordance with a Pre-conceived Plan—The Yearly Program Should be Determined Well in Advance

By **FRANK RUTHERFORD**
County Engineer, Lincoln County, Ont.

Before Conference of County Road Superintendents and Engineers of Ontario

The subject of this paper would seem to indicate that a county road program is a program that can be considered as a disjointed undertaking, and to a certain extent, it would appear to be such if we are to confine ourselves to yearly operation, more or less defined by the working season.

The undertaking of building roads should not, however, be so limited and if such seasonal limit is made there is a strong possibility of having a disjointed product and it seems to the writer that each year's work should be only one unit in a preconceived structure and that each season's work enters into the scheme only as one step nearer to a final completion of a defined program. We should look upon a road program with a broad understanding of what we want ultimately to do. The whole scheme should be definitely considered and worked out after a careful study of the many things that make up the component parts of a road system.

The county road system was inaugurated to provide a better type of road, suitable for all-the-year traffic, leading from centre to centre of population and to give access to the shipping points most frequently used by such populations not centred in urban municipalities.

A Comprehensive Study of Conditions

The earliest prepartion necessary would seem to be a comprehensive study of existing conditions, detailing present and anticipated traffic, from which analysis the route to be followed could be determined. From the same census the importance of the various roads could be ascertained and these roads might be classified into two main divisions, primary and secondary roads. This determination of the importance would then suggest that on a primary road, to carry a more or less accurately ascertained traffic, a heavier and better type of foundation and more lasting surface treatment would be required and that provision should be made for such a program before any construction work is done. The secondary road it not necessarily a through road but it should be made as nearly so as possible, although the traffic requirements will practically determine its character.

The whole county road system should be divided somewhat as above, the primary road being the first to be constructed. If this division were made and adhered to, it would make the county authorities more or less accurately determine the financial requirements and enable them to construct such types of road as would ensure a minimum of maintenance charges with the maximum service.

Too much stress cannot be laid on this early preparation of the program because it would seem that a great many counties have more mileage of roads in the system than can be economically constructed up to a requisite standard and the tendency is to try and construct all roads in the system without giving enough thought to the primary road without which the secondary road would be of reduced value. Unless such primary road is adequately constructed there is an increased reduction in the usefulness of the work, primary and secondary.

Early Detailing of the Year's Work

The yearly program is only an incidental in the development of the road scheme but is as important in its detail as is the whole general scheme. In the province of Ontario the climatic conditions are such that there is a sharp break in the building season of each year and this break has led us to consider each season as a unit. As the whole general scheme should be prepared in advance, so should the yearly program be prepared well in advance of the actual building season. The building season may be considered as extending from May to October except in exceptionally favorable years and the program for that reason should preferably be determined in the months of November and December. All necessary preliminary data can be then ascertained at a great advantage and with the data available from the year previous the two winter months can be very usefully employed in working out detail which is apt to be neglected when the rush of construction is under way.

This early detail preparation would make it possible to have all the next season's requirements of steel for bridges, culverts, guard rails, etc., ordered and delivered at a time when the demand naturally is slack and would have a tendency to give better service all round. It would also give the manufacturer some idea of the requirements to be met and he would also prepare his plans accordingly for any portion of the work which would be allotted to him. It would enable him also to produce his goods at a somewhat better standard by allowing his organization to give more and better attention to detail which he could not do when things are ordered in a hurry.

By the early preparation of the yearly program the superintendent can study out the source of supply of his materials and complete his plans and organization for the most efficient handling of such material. If the work is to be done by contract it gives the contractor ample time to thoroughly consider the work and to gauge his organization to meet the season's demand and enables both county and contractor to start at the first of the season instead of waiting until a portion of the best building weather has passed away.

Modern Road Building Machinery

Descriptions of the Equipment That is Now Considered Necessary for the Construction and Maintenance of Highways—Hand Methods Have Little Use in Modern Road Building Operations.

By E. H. BECK, C.E.,A.M.E.I.C.

During the last few years the art of road making has received a very great deal of attention. Many very fine and instructive articles have been written, and a great deal of space given to the subject in the various engineering publications. However, in contrast with the number of articles describing and outlining details of results obtained in the building of our road systems, very little attention has been given to the machinery and equipment used in obtaining these results. Like the roads, the machinery has improved with the times. Experience is a great teacher, and however well we design our roads or the machinery to make them, it is always experience which is the deciding factor in the long run.

Motor car and motor truck traffic is the direct cause of the need for stronger and better roads, and therefore the additional cost is chargeable to their account, but we must also remember that they are compensating for this by being a great factor in reducing the cost of building and maintaining these roads by giving us the necessary power and energy for the work.

The importance of our road systems, entailing in their condition as they do today, the best engineering skill and ability combined with experience, has enhanced the importance of our road superintendents throughout the country. Those responsible for our road systems are realizing this fact, and it is pleasing to note that unqualified men are rapidly being replaced by those with the necessary training, qualifications and experience. In like manner the machinery, which was in the past left more often to the village blacksmith to improvise, is now designed and improved upon from year to year by the mechanical engineer; in fact, is today being manufactured in large quantities by companies whose entire engineering staffs and equipment are devoted to producing machinery exclusively for this use and for allied industries manufacturing the material for use on the roads, such as quarrying, etc. Thus the reader will realize that just as our road making is demanding the best skill of the civil engineer, so is the machinery demanding the best effort on the part of the mechanical engineer, and as always, it is experience, combined with their mechanical ability, which enables them to keep pace with the ever changing conditions and demands made upon them.

In the first place it is the writer's intention to give a short description of the different machines in use, noting the various necessary adjustments together with interesting mechanical features; after which will be taken in the order named, the important points in selecting, using & caring for the equipment.

Possibly the first piece of road machinery, if it can be called such, was the old split-log drag, which might very well have been evolved by some bright intellect through his having dragged innumerable logs out of the bush for building the old time corduroy road. This stage might be called the evolution from hand labor to that of animal power, from which we have advanced into steam, and now finally into Internal Combustion motors or tractor power, the use of which has succeeded in bringing the graders and other equipment up to the present high standard of efficiency.

The Grader

From the standpoint of the township or county road superintendent, one of the most essential machines is the road grader. This versatile machine is in demand from start to finish, both in the building and also in the maintenance of roads. It is used in making the ditches, levelling off the roadway and forming the crown, levelling and distributing the surfacing material, etc., and maintaining the roads and ditches after completion.

In figure 1 is shown a typical modern road grader, fitted with a reversible blade. In the cut the blade is turned in order to demonstrate the method of attaching it to the frame, and also to accentuate the reversible feature. The arched frame makes it possible to tilt the blade to a higher angle than that afforded by the old type of level frame. The blade and edge

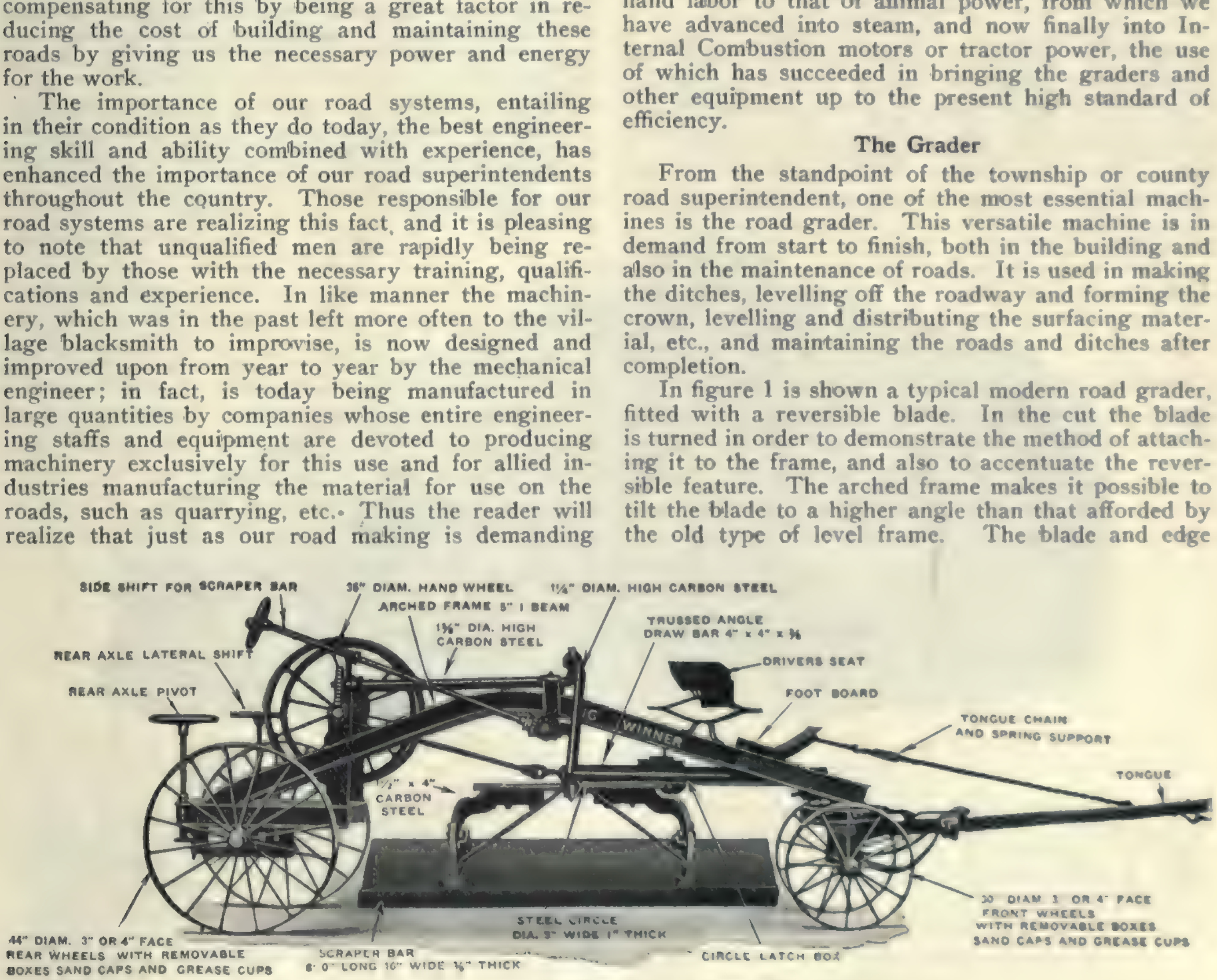

SIDE SHIFT FOR SCRAPER BAR
36" DIAM. HAND WHEEL
1¼" DIAM. HIGH CARBON STEEL
ARCHED FRAME 5" I BEAM
1⅜" DIA. HIGH CARBON STEEL
TRUSSED ANGLE DRAW BAR 4" x 4" x ⅜
REAR AXLE LATERAL SHIFT
DRIVERS SEAT
REAR AXLE PIVOT
FOOT BOARD
TONGUE CHAIN AND SPRING SUPPORT
WINNER
TONGUE
½" x 4" CARBON STEEL
30" DIAM. 3" OR 4" FACE FRONT WHEELS WITH REMOVABLE BOXES SAND CAPS AND GREASE CUPS
STEEL CIRCLE DIA. 5' WIDE 1" THICK
44" DIAM. 3" OR 4" FACE REAR WHEELS WITH REMOVABLE BOXES SAND CAPS AND GREASE CUPS
SCRAPER BAR 8' 0" LONG 16" WIDE ⅝" THICK
CIRCLE LATCH BOX

Fig. 1—A typical road grader with reversible blade

should be of high carbon steel, adjusted so as to be easily swung or reversed from side to side, lifted or lowered at either end, and easily secured and controlled in any position. Another necessary adjustment is the side shift, which enables the blade to be moved outward at either side of the machine. The lateral shift enables the operator to move the frame bodily from side to side on the axle, there being also an adjustment for pivoting the rear axle. These latter adjustments enable the operator to keep his machine in line with his work, being especially necessary in the heavy grader operated by a tractor.

The weight of the machine shown in figure 1 is about 3,300 lbs., and can be used with from four to six horses but a tractor or other motive power is desirable with this weight of machine. In figure 2 is shown the rear view of a similar machine, which is heavier than the former, being about 5,900 lbs. and exclusively for use with motor or steam power. The cut shows the operating end of the steering device, the horse tongue being replaced with a steering pole constructed of pipe, made telescopic and so arranged that while the tractor or engine is driven in the centre of the road, the grader may be steered to either side at will, as when ditching, etc.

Figure 3 shows a much lighter grader, built on the same arched frame principle, operated and driven by one man. The weight is about 1,150 lbs., and makes an ideal machine for township work.

Owing to the heavy duty work which is expected of the road machine great care has to be taken with regards to the choice of materials for its various parts, the use of the right class of material in exactly the right place is essential to the production of a good serviceable machine. At this point it might be as well to give an explanation of the materials with reasons for their use; for instance, cast iron, or grey iron, as it is more often called, although the cheapest of the casting materials is often the best material for use in certain parts and can be used to advantage where malleable or steel would only be a waste of good material and a source of additional cost, with no corresponding increase of strength in the machine.

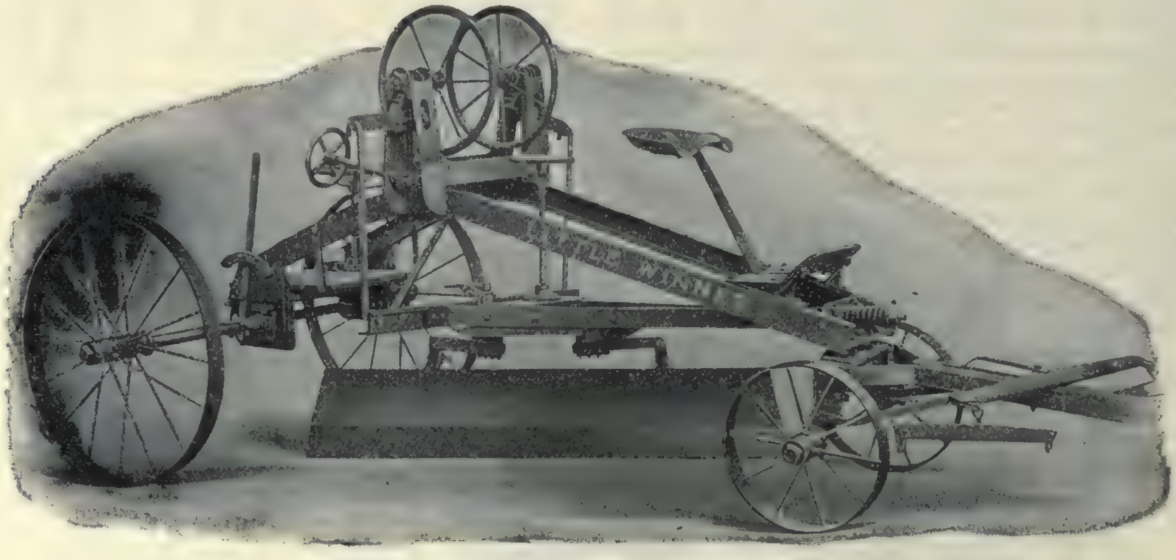


Fig. 3—Light grader with arched frame

In order that the reader, who may not be familiar with the manufacture of iron or steel, might more readily grasp the difference in gray iron, malleable and steel castings, it might be explained here that gray iron is practically the first product of the blast furnace, (the first process in the reduction of the iron from the ore), the pig thus obtained being simply remelted in a cupola or air furnace and run into moulds, very little if any chemical change taking place in this remelting. In making malleable castings the metal is changed somewhat by an oxidizing melting which produces a white cast iron and is very brittle, but a long heating or annealing treatment produces the malleable nature and strength. Cast steel is a product of the blast furnace but is greatly purified by puddling and the crucible process where the impurities are removed.

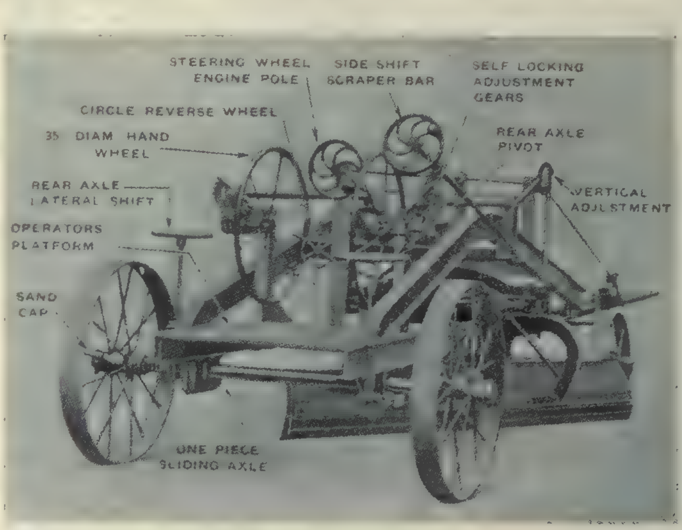


Fig. 2—Road grader with special steering device

As in the castings, so the greatest care has also to be taken in the choice of material for the forged parts where steel shafts and flats of varying degrees of carbon content are used. The cutting edge for instance must necessarily be of first class high carbon steel.

The modern graders are made in various sizes to accommodate the varying conditions and nature of work for which they are intended. The general weights with sizes of blades, horse power required for operating, etc., is as follows:

Blade	Weight	Power Required
(1) 760 lbs.	5 ft. 0 in.	2 horses.
(2) 1150 lbs.	6 ft. 0 in.	2 horses.
(3) 1570 lbs.	6 ft. 0 in.	2 to 4 horses.
(4) 2700 lbs.	7 ft. 6 in.	4 to 6 horses.
(5) 3375 lbs.	8 ft. 0 in.	6 to 8 horses or 12 to 15 h.p. tractor.
(6) 5980 lbs.	10 ft. 0 in.	20 to 30 h.p. tractor.
(7) 7200 lbs.	12 ft. 0 in.	30 to 40 h.p. tractor.

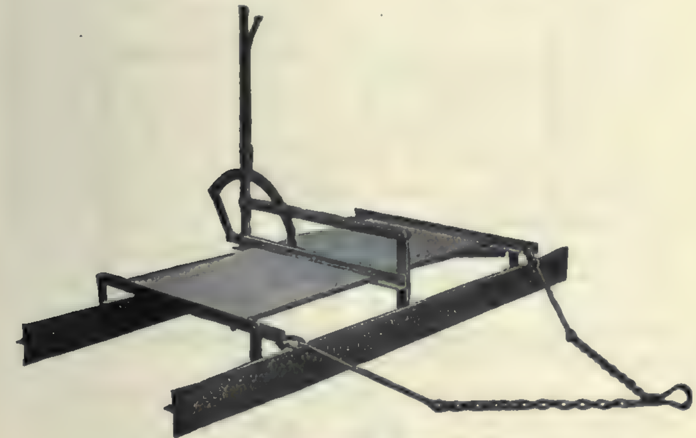


Fig. 4—Steel drag with adjustable blades

Numbers 1, 2 and 3 would be considered light road graders; numbers 4 and 5, the heavy type, and numbers 6 and 7, the specially heavy, for use in work on a large scale. It is however, the tendency to-day to use a battery of the lighter machines, which are far more pliant, especially on the township roads or county highways.

The Drag

The old split-log drag is now replaced by one of steel, the modern type of drag having independent adjustable blades, as shown in Figure 4. The adjustable feature makes the machine much more pliant than the old fixed blades, as with different adjustments the operator is able to cut, crush, pulverize, pack, smooth and carry earth. The following blade movements will give an idea of the diversity and usefulness of this machine:—

(a) Both blades may be fixed erect.

(b) Front blade at cutting angle, rear blade erect.

(c) Front blade at cutting angle, rear blade at crushing angle.

(d) Front blade erect, rear blade at crushing angle.

(e) Both blades at crushing angle.

(f) Both blades at cutting angle.

For the cutting angle, the blade is fixed with the cutting edge forward and in the crushing angle the blade would be sloped to the rear. The drag is more essentially a maintenance machine. There is also the three blade grader, built along the same lines as that shown in Fig. 4.

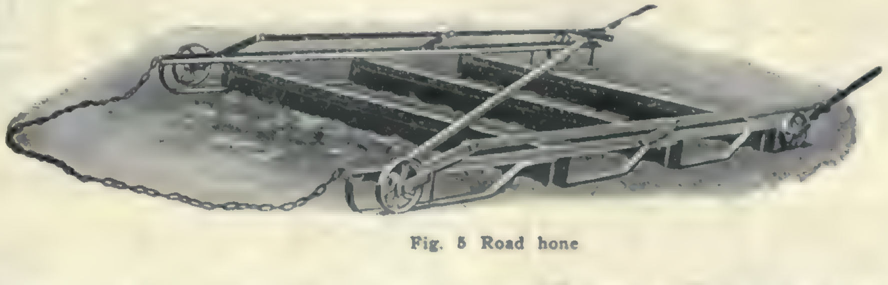


Fig. 5 Road hone

The Hone

Figure 5 shows the machine, which in the writer's opinion, even replaces the road drag, although the two machines can be worked to advantage in conjunction with one another, the drag cutting off the high spots and the hone smoothing and puddling the road.

The machine consists of three blades attached to side runners and at an angle to the direction of the road. At the lower end of each blade an opening is left in the runner to allow the accumulation of earth to spill past the blades. Four wheels are attached for use in hauling the machine to and from the work, being lifted or lowered by means of a lever.

The drag will more or less follow the contour of the existing surface of the road, whereas the hone, owing to the effect of the runners and the length of the machine (which is 10 feet over all), forms the roadway, filling in the hollows and removing the high spots, thus maintaining the principle of honing which is essentially smoothing and puddling.

The dimensions of a standard hone are:—length, 10 ft.; width, 5 ft. 6 in., height, 8 inches. It weighs from 400 to 450 lbs. and is easily drawn by one team.

(Continued in the Next Issue)

Engineering bulletin No. 1 has been issued by the Maryland State Department of Health. The bulletin was compiled by chief engineer Robert B. Morse and contains a number of papers selected from many that have been prepared either entirely or partially by members of the engineering force of the State Department

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The Tube and Machinery Co., handling Canadian business for the Mannesman Tube Co., have recently located at Room 16, 224 St. James St., Montreal. The business is under the joint management of F. J. Hyde, E. C. Girouard and E. Voltchmar.

New Registered Engineers in British Columbia

At the last meeting of the Association of Registered Professional Engineers of B. C., held in Vancouver on February 18, four new members were admitted: C. P. Browning, general manager of the Britannia Mining & Smelting Co., Ltd., one of the largest producers of copper on the coast; F. A. Devereux, Victoria, a civil engineer of long standing in the province; Wm. McGhee Young, who was controller of water rights in the Department of Lands, from 1913 to 1919, and now in private practice as a consulting engineer in Vancouver; Col. J. P. McKenzie, consulting engineer, and superintendent for the contracting firm of Loomis, McFee, Henry & MacDonald, Ltd., Vancouver.

The Contract Record's

Weekly House Suggestion No. 13

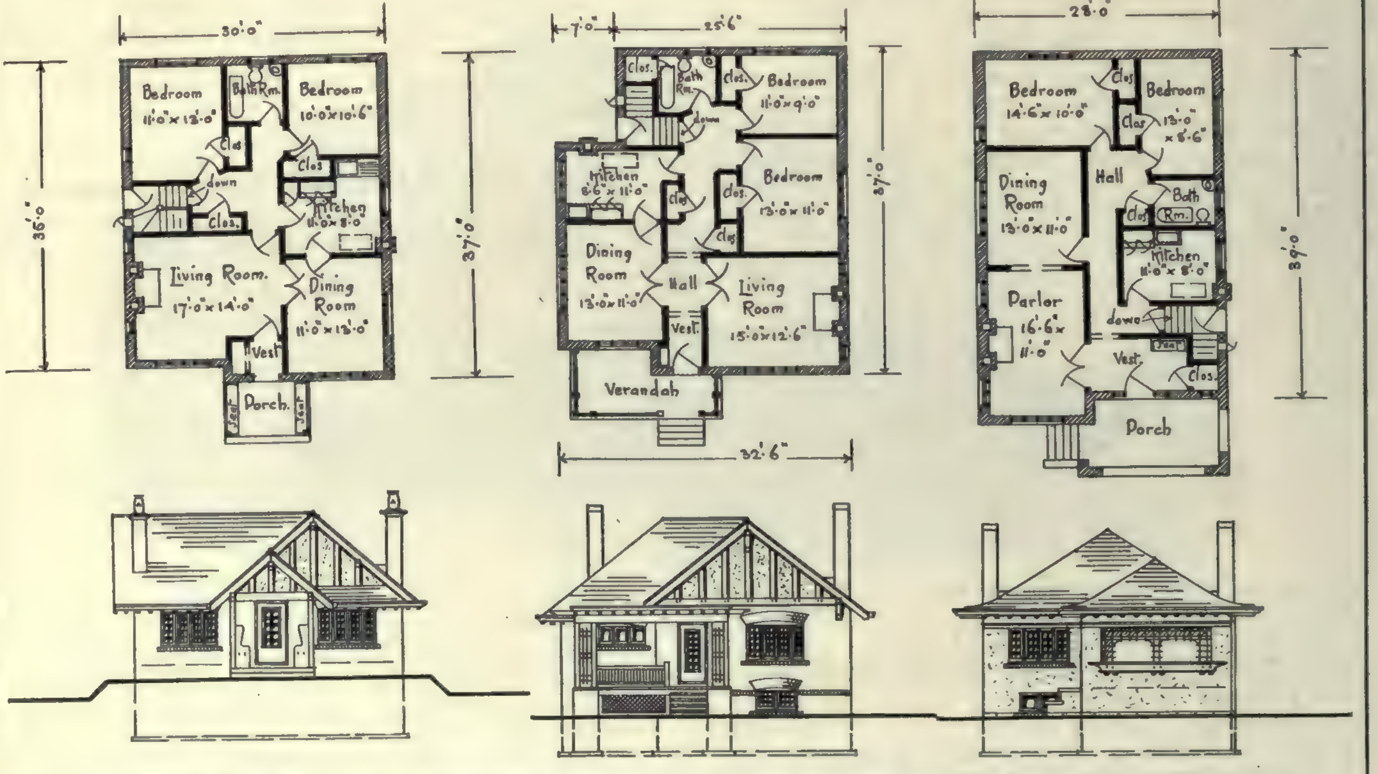
Bungalows, that is, real one storey bungalows, have been introduced into Canada to some extent and will, no doubt, from now on, become more popular as increased facilities of transportation make suburban districts more accessible. Bungalows, as built in the southern states, would not entirely suit Toronto, but they can be easily adapted. The custom of entering through the front door directly into the living room will need revising, to suit most people in Canada. A glance at the acccompanying sketches will show that all the features desirable in any house can be embodied in a bungalow; access to the front door from the kitchen, without going through any room; access to every room in the building from a passage and not from some other room; privacy of bedroom quarters; a large living room; at least one large bedroom; plenty of cupboards and other conveniences. These are features that are indispensable, but always available. A good sized trap door in the ceiling, in a convenient place, is necessary to give access to the roof for storage purposes.

Among the advantages of this type of house may be mentioned the saving of labor in climbing stairs. The possibilities of planning the rooms to the best advantage, to suit conditions such as size and shape of lot and general aspect, are so great that it can be reasonably said that no two bungalows need be built alike.

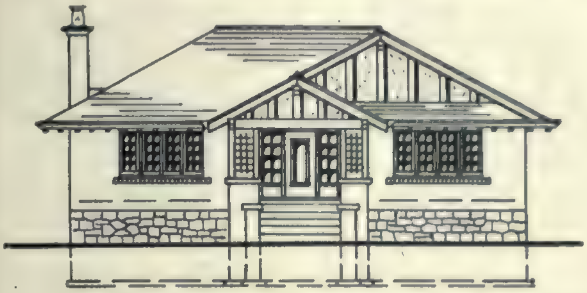
As may be seen from the sketches, bungalows may, for the purpose of planning, be classified into three types: (1) narrow (about 22′ 0″) and correspondingly long; (2) square, (naturally the easiest to heat), and (3) wide. The sketches illustrate these types, and combinations of these types, expressed in their simplest terms, and may be elaborated upon and varied according to requirements and conditions. Verandahs and sleeping porches and other additions can be built on as requirements may suggest. Generally speaking, a fair sized, well built, six-room house, of two stories, will correspond in bulk and cost with a one storey bungalow, of an area of 1,000 to 1,100 sq. ft. Such a bungalow will consist as a rule of five rooms on the main floor, with another good sized, well lighted room in the basement, preferably under the living room, with fireplace in it. The room in the basement can be used as a den, billiard room, playroom, or for any other such purpose, and should be at the foot of the stairs, the stairs being near the kitchen, but approachable from other parts of the house, without going through the kitchen.

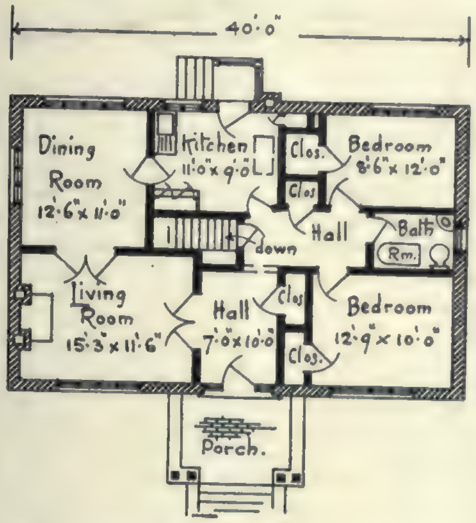
In cases where more than six rooms are required, additional rooms in the roof, on a second storey, will naturally suggest themselves in preference to extending the area of the building beyond reasonable proportions.

The plans and data accompanying this article were supplied by P. H. Finney, Architect, 79 Adelaide St. East, Toronto.



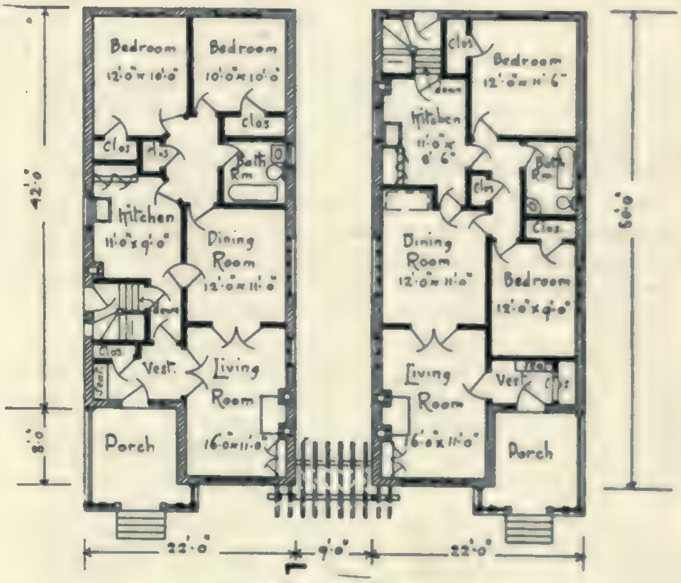
The above sketches show three examples of the popular, economical square-plan bungalow. The first is of the California type, with entrance directly on living room. Centre plan shows convenient layout of rooms off a through hall. Plan illustrated at right deviates slightly from the square. Kitchen arrangement is an innovation in this layout.

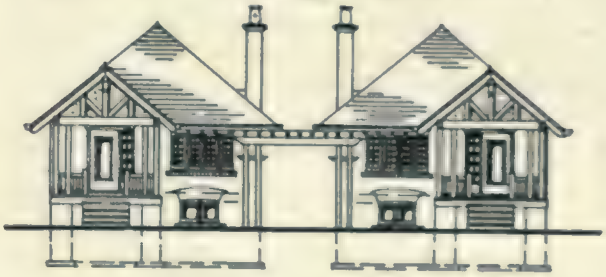


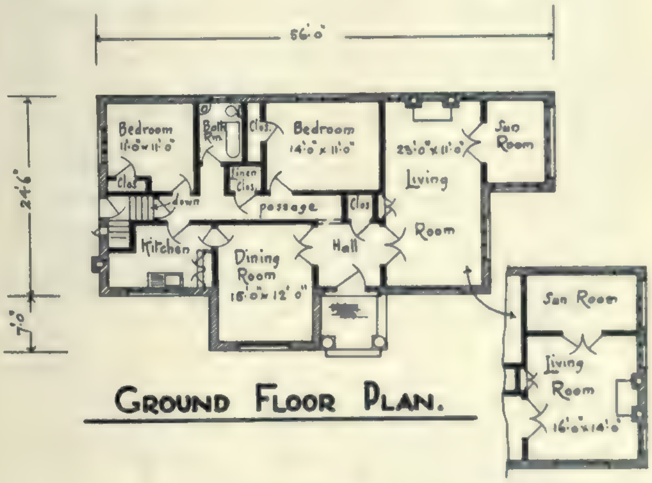


At the left is a very popular type of bungalow, allowing a convenient layout of rooms. Very little space is taken up by passage space, yet practically every room is accessible without passing through other rooms. This plan could be reversed, putting the entrance on the side and re-arranging the plan, should it be desired to construct the house on a narrow lot. This type of bungalow is economical, every foot of space being utilized.

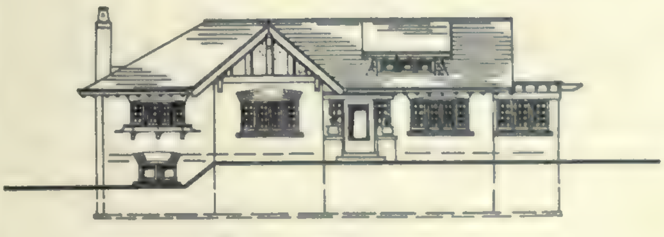
The illustration on the right shows two slightly varied plans for the narrow type of bungalow, suitable for construction on a long, narrow lot. The plan on the left is, in the author's opinion, the more desirable, in that it makes the kitchen accessible from the front door without passing through any other room. The plans suggest the possibilities of layout in the unusual, narrow-type bungalow.







GROUND FLOOR PLAN.



ELEVATION.

The type of bungalow illustrated at the left, as in the case of No. 4, is suitable for construction on a corner lot. This illustration suggests the possibilities of the five-room bungalow dwelling, where economy is not the chief essential. The exterior of this bungalow could be made to present a very attractive appearance. An alternative plan of dining room and sunroom layout is shown, which, while not as elaborate would mean a saving in the cost of the house and yet provide ample space for both these rooms.

Public School at Beeton, Ont.

E. H. Horton, Hamilton, has just received the general contract for the erection of a Public School building for the School Board of Beeton, Ont., and is commencing work at once.

Mainly Constructional

East and West—From Coast to Coast

The stonecutters at Ottawa have agreed to a five cent cut in wages, to take effect May 1. The men are at present receiving 90 cents an hour.

Work of demolition of the old hotel property at the southwest corner of Bay and Adelaide streets, Toronto, will be commenced shortly, it is announced, to make way for a new $100,000 office building. The property has a frontage of 98 feet on Bay St. and 158 ft. on Adelaide St.

Although Montreal's building permit figures for February more than doubled those of the previous month, they were $90,000 under the total for the month of February, 1921. Last month permits totalling $536,475 were issued, made up of $398,475 for new construction and $138,000 for repairs.

Money by-laws totalling $433,664 will be submitted to the ratepayers of Edmonton, Alta., shortly, covering a number of public works and new utility impovements, including extensions of the civic power plant, a new telephone exchange, swimming pools, street work, and local improvements.

An American firm, the Fedders Manufacturing Co., of Black Rock, N. Y., have purchased the plant of the Lantz Marble Works, on Lewis St., Bridgeburg, Ont., and will manufacture automobile radiators, airplane accessories, etc. The new company will employ, it is stated, a staff of 200 within a year.

It was announced that a company is being formed at St. Thomas to manufacture fancy brick by a new process. By this process it is claimed that brick may be manufactured from any soil, whether it contains the clay constituent or not. A sample of the brick was exhibited at a recent meeting of the Kiwanis Club in St. Thomas.

The new $300,000 filtration plant at Peterborough, Ont., is now in partial operation, and the improvement in the quality of water is distinctly noticeable. The plant is being tested out each night, and the day requirements are taken from the two-million gallon reservoir. This plan will continue until the tuning-up process has been completed to the satisfaction of the contractors and engineers.

A building exposition, being held under the auspices of the building trades of Vancouver, opened on March 11, in the Cassidy Building, at that city, and is continuing until March 25. The feature attraction of the exhibition is a modern $5,000 bungalow, constructed in a beautiful natural setting. The purpose of the exposition is to create interest in house building during the 1922 building season.

There are rumors in Toronto that a modern eight-storey fireproof building will be erected at the corner of Sheppard and Richmond Sts., to accommodate a modern garage, cafeteria and roof garden, besides general office and showroom space. It is estimated that this structure would cost $750,000 including the cost of the land. Messrs. Yolles & Rotenberg, Limited, are mentioned as the contractors, in conjunction with the General Building Corporation.

Additions being erected to grain elevators at Fort William and Port Arthur, Ont., will bring the grain storage capacity of these twin ports to $57,793,000 bushels this year, in 33 elevators. This gives the Canadian twin cities the largest grain storage capacity of any port in the world. Hitherto, the American twin ports of Minneapolis and St. Paul claimed this distinction, there being 65 elevators in these two cities, with total capacity of 55,195,000 bushels.

York County, Ont., is continuing to show increases in the amount of building carried out during the present year, compared with last year. Permits for structures valued at $457,450 were issued during February of this year, as against $294,000 for the same month last year. A favorable feature in connection with this work is that the majority of it is house construction. From present indications, it looks as if a new record for the month of March will be made this year.

Indications point to a disagreement in mining labor circles in the West. District 18, United Mine Workers of America, at Calgary, recently presented demands for the five-day week, six-hour day and increases in wages, which were refused by the officials of the Western Canada Coal Operators' Association. The latter body also announced that they are posting a new agreement, to go into effect on April 1, providing for a considerable reduction in wages, which the men say they will not consent to.

At the seventh annual meeting of the Granite and Marble Dealers' Association of the province of Quebec, which was held in Montreal recently, the following new officers were elected: Messrs. Jos. Murphy, Montreal, president; E. I. Baron, St. Hyacinthe, first vice-president; E. Labrecque, Quebec, second vice-president; Arthur Breault, Valleyfield, secretary-treasurer; executive committee, A. L. Smith, Montreal; Jos. Brunette, Montreal; J. P. Laurin, Ottawa; P. A. Poulin, St. John's; J. A. Rolland, Quebec. Mr. H. S. McLeod, of Toronto, was elected district organizer; Mr. N. Daudelin, of St. Hyacinthe, sergeant-at-arms, and Mr. R. D. Brodie, of Iberville auditor. The summer convention will be held at Three Rivers, P. Q.

At a recent meeting of the Engineering Institute of Canada, in Montreal, the awarding of the Czowski, Plummer and Leonard medals took place. The Czowski gold medal was won by Mr. P. Ackerman, of the Shawinigan Power Company, for his paper on the Relay Protective Features of the Toronto Transmission & Distribution System. The Plummer Medal, presented and endowed by Mr. J. H. Plummer, of the Dominion Iron & Steel Co., for the best paper each year on metallurgical subjects, was won by Dr. Alfred Stansfield, professor of metallurgy at McGill University for a paper on that subject presented during 1921. The first presentation of the Leonard Medal was made to Col. R. W. Leonard, of St. Catharines, in recognition of his generosity in providing the endowment for the annual presentation of this medal.

Personal

Messrs. Walker & Gibson, architects and engineers, have opened offices at 70 Victoria St., Toronto.

Mr. F. W. Pennock announces that he has resigned as vice-president and general manager of Cleaton Co. (of Canada) Ltd., and will hereafter be solely connected with the firm of Gelinas & Pennock, Reg'd., engineers, 207 St. James St., Montreal.

Trade Incorporations

Provincial Homebuilders, Limited, with head office at Toronto, capital $40,000, to carry on a building and real estate business.

ESTABLISHED 1886

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Forest Fire Losses to be Minimized by New Quebec Legislation

The bill of the Quebec Government, dealing with the fire protection of forest and reforestation, is of interest to the constructional industries. The connection between this subject and contracting may seem a bit remote, but it bears the same relationship to the industry as the source of any other material which enters into building. Any measure designed to protect our natural resources, and particularly those used in construction, necessarily demands the attention of our readers.

The enormous destruction of forest wealth which takes place every year is not sufficiently recognized. Forest fires, principally caused by carelessness, are looked upon by the public as inevitable and their occurrence is more or less disregarded. The records of the forest protective associations prove that these fires can be prevented if proper precautions are taken and if there were more keen appreciation of the economic losses caused by fires. If millions of dollars of any other necessary raw material were annually destroyed, there would be a great outcry but in the case of our forests, there is an indifference which can only be accounted for on the supposition that the public does not realize the far-reaching effects of the fires. While there has been a certain awakening on the subject, the fact that hundreds of preventable fires occur year after year shows that the public conscience is not yet sufficiently aroused to the gravity of the situation.

The bill referred to has for its object the more effectual protection of the forests and reforestation. Some of the clauses dealing with penalties are drastic but are no more severe than the conditions demand. Neglect to prevent fires spreading when debris or trees are being burned is punishable by fines ranging from $25 to $200, the onus of proof that a fire on an owner's land was not started by him or his employees being placed on the owner. Sawmill or other buildings in a forest or less than a mile from a forest, must be provided with approved apparatus to prevent the escape of fire and sparks and as a further precaution, persons may be prevented between April 1, and November 15, from entering districts to be known as fire zones, unless provided with a permit. Other provisions are also made for the prevention of fires, together with penalties for the infringement of the law.

This destruction from fire and also the wasteful methods of logging necessarily affect the supply of lumber and the price at which it can be sold—an aspect of the subject which is of direct interest to contractors, inasmuch as it has a bearing on the cost of construction. Canada is slowly but surely using up her forest wealth at a greater rate than it is being replenished by natural means. We have no reforestation policy as in the Scandinavian countries, where they are more dependent upon their lumber as an industry than we are in Canada. Here each province, except in the West, is responsible for the administration of the natural resources and a national policy of conservation is therefore impossible. Quebec is probably the most progressive of all the provinces in the matter of preserving forest wealth, the new legislation going further than any previous proposals in this direction. In addition to the prevention of fires, the Bill provides for the encouragement of reforestation, for the prevention of illegal cutting of timber on public lands, for the disposal of slash (a great cause of fires), and generally for safeguarding the forests.

Canada's Fire Loss Jumps to $5.22 Per Capita

Fire losses in Canada for 1921 amounted to $5.22 per capita, as compared with $0.90 per capita in Great Britain, according to information made public by the Dominion Fire Commissioner. During the year the 25,916 fires reported to the department of insurance occasioned property damage amounting to $45,015,930, exclusive of incalculable loss arising from forest fires, the commissioner points out.

The 1921 fire loss, of which approximately $34,000,000, or 75 per cent. was covered by insurance, constituted a substantial increase over the losses of the three previous years. In 1920 the loss amounted to $28,745,590; in 1919, $25,361,240, and in 1918, $33,817,050. During 1921 the fire losses in Great Britain only amounted to $36,400,000.

By provinces the distribution of fire losses during 1921 was as follows: Alberta, $2,875,000, or $4.95 per capita; British Columbia, $3,050,000, or $5.82 per capita; Manitoba, $2,864,000, or $4.67 per capita; New Brunswick, $2,725,982, or $7.02 per capita; Nova Scotia, $3,177,000, or $6.06 per capita; Ontario, $15,444,817, or $5.28 per capita; Prince Edward Island, $216,478, or $2.44 per capita; Quebec, $10,897,653, or $4.64 per capita ,and Saskatchewan, $3,755,000, or $4.93 per capita.

Reports by municipal officers show that the losses in cities having populations of more than 10,000 population amounted to $13,616,951, or $4.29 per capita;

in towns of from 1,000 to 10,000 population, $6,184,085, or $7.32 per capita, and in villages and rural districts. $25,214,894, or $5.31 per capita. In places having municipal fire protection systems the loss was $4.90 per capita and in unprotected places $5.25 per capita. There were 59 fires where the loss exceeded $100,000; 46 with losses of from $50,000 to $100,000; 261 with a loss of from $10,000 to $50,000; 3,992 with a loss of from $1,000 to $10,000, and 21,558 with a loss of less than $1,000. The 59 larger fires entailed an aggregate loss of $15,824,801, and the 21,558 smaller fires a loss of $4,644,817.

Classified according to the character of the property involved, the more destructive fires occurred as follows: 49 in industrial property, with a loss of $8,188,200; 32 in mercantile property with a loss of $5,659,000; 9 in institutional property with a loss of $1,948,561, and 15 in miscellaneous property with a loss of $4,301,465.

The amount of money spent by the Dominion and provincial governments upon fire prevention work in 1921, amounted to $125,000, all of which, with the exception of $12,000 was raised by a tax upon insurance companies.

Victoria to be the Meeting Place of the Canadian Good Roads Association

The announcement is made by the Executive of the Canadian Good Roads Association that the ninth annual convention of the association will be held at the Empress Hotel, Victoria, B. C., on Tuesday, Wednesday, Thursday and Friday, June 13, 14, 15 and 16. The choice of the capital of the Pacific coast Province marks the fulfilment of the desire of the controlling heads of the association to emphasize its truly national scope by so selecting convention points that each section of the Dominion shall be visited in turn. They may now truthfully claim to have covered Canada from coast to coast, the 1921 gathering having been held in Halifax, while the seven previous conventions were distributed as follows: Two in Montreal, and one each in Toronto, Hamilton, Ottawa, Quebec and Winnipeg.

The convention is being held in direct co-operation with the Good Roads League of British Columbia and the good roads associations of the western provinces. The official recognition extended to the Canadian association is indicated by the fact that assurances have been received of the presence as delegates of Dominion government highway officials, provincial ministers with their deputy ministers and chief engineers, highway commissioners and the mayors, councillors and engineers of many municipalities. There will also be representatives of contracting firms, suppliers of paving materials and machinery and the automotive interests. Messrs. S. L. Squire and William Findlay of the executive committee made a special trip to the coast to arrange the preliminaries of the convention, and both in British Columbia and while en route through the West, they received repeated assurances of interest in and support for the convention.

Comprehensive Program

Secretary-treasurer George A. McNamee is now preparing at the association's head offices in the new Birks building, Montreal, the tentative program for the convention. It will include addresses by distinguished highway authorities of Canada and the United States, and will be even more comprehensive than at any previous convention, as an extra day will be devoted to business sessions, making four days instead of three. For the fifth day, Saturday, a number of sightseeing trips will be arranged which should prove both educative and entertaining.

Considerable attention will be given in the agenda to the experience gained in the course of the past two years in connection with Federal highway aid. Statistics collected by the Dominion authorities show that up to September 30 last approximately 50 per cent of the Federal appropriation of $20,000,000 has been absorbed. Eight provinces had participated (Alberta being the exception), and in all 126 projects had been undertaken, representing a total mileage of about 3,800 miles and an estimated total expenditure of $24,000,000, with 40 per cent of this sum being drawn from the Dominion grant. Other subjects to be discussed at the convention include cost data, highway financing, economical methods of improving earth roads, and greater attention to maintenance.

The Canadian Good Roads Association is a member of the Permanent International Association of Road Congresses, and has the right to send five delegates to the convention of that body, the next of which will be held in 1923 at Seville, Spain, after being left in abeyance during the war years. It is probable that at the Victoria convention a proposal will be made to invite the International Association to meet next in Canada, either in 1925 or 1926. If such an invitation is extended and accepted it will be the first time that the International Association has held a convention outside of Europe. Meanwhile the executive of the Canadian Association has asked the governing body of the International Association to send one or more delegates to the Victoria convention.

The president of the Canadian Good Roads Association is Hon. S. J. Latta, former Minister of Highways for Saskatchewan, and now Minister of Education for that province. He has been taking a close personal interest in all the arrangements for the convention, and will preside over most of the business sessions.

As in former years, the main convention will be supplemented by special conferences of allied interests. These will include the second annual interprovincial conference of government highway officials, who will hold sessions on all three days of the convention, the second annual conference of the provincial good roads associations, with one session, and the second annual conference of municipal road officials, with one or more sessions.

Stoker Catalogue

The Combustion Engineering Corporation. New York City, are distributing a folder describing their Type K Stoker for operating boilers ranging up to 200 h.p.

The St. Patrick St. Bridge, Ottawa, Ont,

Four-Arch Reinforced Concrete Bridge on St. Patrick St., Ottawa

Old Bridge Over Rideau River Replaced with a Modern Structure Totalling 650 Feet in Length—Deck has 2.28% Grade—Details of Design and Construction Methods

By our Ottawa, Ont., correspondent

The city of Ottawa has lately completed the first of two concrete arch bridges, which will replace two old steel structures built in the early days when Ottawa was known as Bytown and which had become inadequate for the heavy traffic going over them. This new bridge, a description of which appears in this article, crosses the Rideau river along St. Patrick street and links the lower town to New Edinborough and the new Linden Lea suburb

Designs for steel and concrete structures were first submitted, but after proper consideration of cost and appearance, the concrete type was decided upon and the contract for such a bridge was awarded in the spring of 1919. The vehicular traffic at the bridge location was suspended during the period of construction, but a temporary walk for the convenience of pedestrians was installed a short distance north of the bridge site. This was removed in the fall and laid down again in the spring.

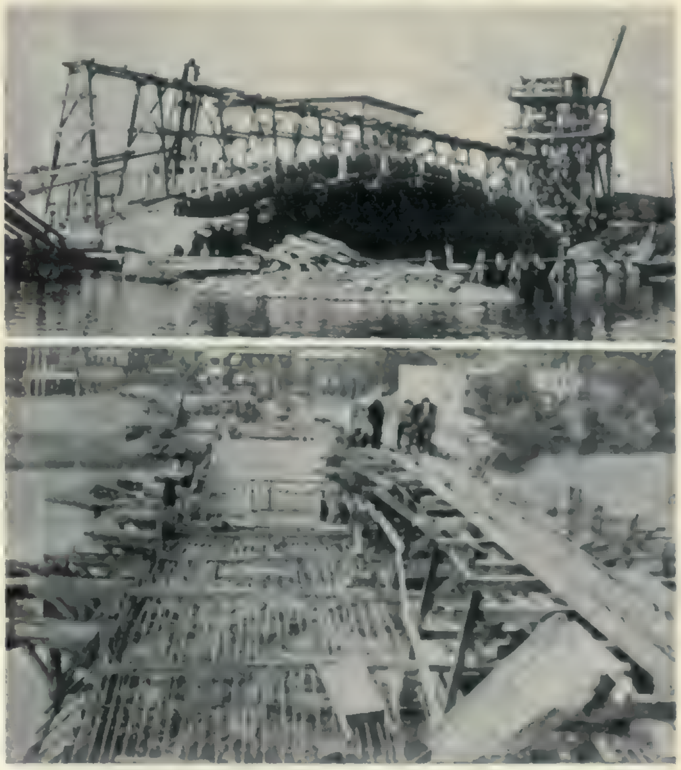
The new structure, which is designed for heavy traffic, was opend to traffic in October last. It consists of four equal arch spans, each 123 ft. from centre to centre of piers, and carries two street car tracks, two roadways and two seven foot walks. The total length of the bridge, including fill and approaches is approximately 650 ft. The Rideau river at Ottawa is noted for ice jams, principally near the site of the new bridge, causing frequent floods. Consequently, the bridge was built with a rising grade of 2.28 per cent. toward the centre in order to provide sufficient clearance for the high spring water. The grade follows a straight line from each end of the bridge up to 45 ft. on each side of the centre pier, between which points the floor profile follows a light curve, the purpose of which is to eliminate the angle formed at the point of intersection of the two grade lines.

Foundations

The structure was started at both ends simultaneously, the work being facilitated by the rather uniform character of the foundation soil. Little rock drilling was necessary, except for the removal of some heavy boulders and of the top layer of the hard pan on which rest one abutment and two piers, at 16 feet below water level. The other abutment and one of the outer piers rest on solid rock. All excavation was handled by derrick and hauled to the approach fills by cableway, which method was also employed in placing of all materials. The piers are designed with a cut water of the "V" shape, slightly curved at the top.

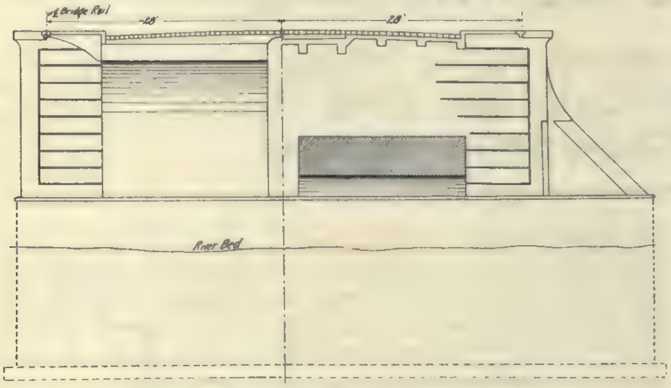
Arch and Superstructure Design

As already stated, the bridge consists of four spans involving three piers, two abutments and a long approach on the north side. The arches of the four spans are of equal length, following an elliptic curve with a 14 ft. 6 in. rise. The arches are built in two sections, 20 ft. in width with a 3 ft. 4 in. opening between but



These illustrations show the arch centering, concrete plant and trestle for the concrete buggies which is cinder filled at the arch crown on a distance of 43 ft. The thickness of the arch rings is 2 ft. 6 in. at the crown, and 7 ft. at the haunch, and they are reinforced longitudinally with 1 in. square twisted bars at 8 in. centres, and tranversely with ¾ in. bars at 3 ft. centres, with ½ in. stirrups. The floor system is supported on transverse spandrel walls the full length of the slab and with which are cast the cantilever beams supporting the sidewalks, the beams being strengthened by brackets of an elliptical shape. The spandrel walls are 43 ft. wide and 12 in. thick, except the pier walls, which are 15 in. thick. The walls are reinforced, horizontally with ½ in. rods placed at 2 ft. centres and vertically with the same size rods placed at 12 in. centres. During the construction of the arches the false work was carried on piles.

The roadway slab is 12 in. in thickness and reinforced with ½ in. rods at 6 in. centres, both ways. The sidewalk slabs are 4½ in. in thickness. The pavement consists of creosoted blocks laid on the concrete on asphaltic waterproofing.



Elevation and half section of one of the piers

The arches were designed to carry 15-ton motor trucks on the roadways, and the largest double truck street cars of 31 tons weight on the trolley tracks. The permissible stress in the concrete was 650 lb. per sq. inch for compression, with 16,000 lb. per sq. in. tension for the steel.

The railing over the arch spans is ornamental iron while over the piers and wing walls, east and west, is an ornamental concrete balustrade. The lamp posts are of an ornamental design of the envelop type, slipping over the trolley poles.

Broken stone was used in all concrete. The mixture for the piers and footing was 1:3:5, and that for all reinforced work was 1:2:4. The structure contains 3,520 cubic yards of mass concrete in the piers and abutments and 4,300 cubic yards of reinforced concrete in the superstructure, together with 195 tons of reinforcing material. Expansion joints are located at piers and abutments. All surfaces that would be seen in an elevation of the bridge are finished by bush hammer and this work was done immediately after the removal of the forms.

The total cost of the bridge was $250,000 which includes $2,300 for the temporary footbridge, $6,500 for the removal of the old structure, $9,000 for the removal of and damage to some small houses, $9,000 for building approaches and drainage of the bridge, $2,800 for the lighting system, $4,600 for the concrete balustrade, $6,500 for the iron railing, $4,500 for the repaving of approaches and $7,500 for incidentals, wages of inspectors, etc.

Inevitable delays and many obstacles had to be dealt with during the construction of the bridge, labor troubles and the scarcity of cement being the principal causes of the delays. Laborers wages had to be increased from 45 to 58 cents per hour, which put the contractors in a rather bad situation, their tender being too low, in fact, lower than the city's tender by several thousand dollars.

The bridge was designed by Mr. Robert Henham, bridge engineer, of Ottawa, with Mr. W. Legault as assistant, under the supervision of Mr. A. F. Macallum, Commissioner of Works. The contractors were Messrs. McDougall Bros. of Ottawa.

Saskatchewan Engineers Meet

Annual Meeting of E.I.C. Branch—Propose to Hold Meetings in Saskatoon

A proposal to hold meetings in Saskatoon during the year for the benefit of members of the Saskatchewan branch of the Engineering Institute of Canada resident in the northern part of the province was approved at the annual meeting of the branch held in the city hall yesterday.

The Saskatoon meetings will be additional to those to be held in Regina and it is proposed to send speakers to the northern city from Regina to stimulate a greater interest in that section of the province.

The business session occupied the afternoon, the evening being devoted to a banquet at the Kitchener Hotel followed by a theatre party at the Capitol.

The convention was well attended. In addition to local members the following were present from outside points: Yorkton, E. B. Webster, F. C. Christie, H. T. Crosbie; Saskatoon, T. W. Brown, F. E. Wootten, A. W. MacGillivray, E. H. Phillips; Moose Jaw, J. R. C. Macredie; Swift Current, P. J. McDonald.

Officers for Year

Election of officers resulted as follows: Chairman, J. R. C. Macredie, Moose Jaw, district engineer for the C. P. R.; vice-chairman, C. W. Dill, Regina, superintendent of highways for the Saskatchewan Government; new members elected to the executive, R. N. Blackburn, Lieut.-Col. A. C. Garner and A. P. Linton, all of Regina; secretary-treasurer, re-elected, D. A. R. McCannel, city engineer, Regina. With the above the following old members complete the executive for the ensuing year. Prof. C. J. McKenzie, Saskatoon; J. W. Calder, Swift Current; G. W. Green, Moose Jaw.

It was reported that the Medical Association had agreed to co-operate with the institute in the provision of club rooms in the city for the use of the various professions, and it is anticipated that the project will be furthered shortly as a result of representations sent out to the Land Surveyors, Dental Association, Law Society and other organizations among professional men.

The retiring chairman, W. R. Warren, of the Saskatchewan Department of Telephones, gave a brief address dealing with details in connection with the betterment of the institute and expressing thanks to the officers and members for their co-operation during the past year.

Votes of thanks and expressions of appreciation of the services rendered by the retiring officers and members of the executive were expressed. The three retiring members of the executive are H. M. Weir, Saskatoon; Lieut.-Col. A. J. McPherson, Regina, and C. W. Dill, Regina.

Speaking at the banquet, Mr. Macredie expressed his appreciation of the honor conferred upon him by his election as chairman and briefly dealt with the past development and future prospects of the association. Mr. Dill also spoke briefly and in the course of his remarks pointed out the splendid opportunities which the future afforded to young men entering the profession, especially in view of the probable impetus which would be given the development of the natural resources as soon as they were turned over to the province for administration.

New Water Works at Courtenay, B. C.

A System for the Supply of Water to the Town is Being Completed —Details of Head Works, Pipe Line and Distribution Mains— Inverted Syphon Section across Puntledge River

By J. B. HOLDCROFT
Consulting Engineer, Victoria, B.C.

The town of Courtenay, B. C., a flourishing little agricultural centre on Vancouver Island with a population of 800, has recently completed the construction of a waterworks system which is to supply the town and vicinity. The scheme is one which has been contemplated for several years, but has been delayed owing to financial difficulties caused by the war, which made it impossible to market the town's bonds at a reasonable figure.

During the summer of 1921, however, arrangements were completed with the E. J. Ryan Contracting Company, of Vancouver, B. C., to install the works and assist with the financial aspect of the scheme, and work has proceeded from that time until the present. The works are now practically complete and only require minor alterations and repairs, following the months of construction under winter conditions, before being finally taken over by the city.

The system was designed by Mr. Donald Cameron, consulting engineer of Vancouver, and very well known among the engineering profession as the inventor or discoverer of the septic tank process during his incumbency as engineer for the city of Exeter, England. The contract price for the works was in the neighborhood of $76,000.00, but the town found it necessary to float a bond issue of $110,000.00 to allow for incidental expenses not covered by the contract and for the costs of financing.

Intake Works

The supply is taken from Brown's River, a tributary of the Puntledge River on which is located the Canadian Collieries' power plant, developing 9400 h.p., and supplying energy to the nearby mines and to the town of Courtenay for lighting purposes. The headworks consist of a concrete spillway dam and intake chamber so aranged that at highwater the river flow passes over the entire structure without injury. No storage is attempted at this point, the dam serving simply as a diversion weir and ensuring at all times a depth of about three feet of water over the intake end of the pipeline. The intake chamber is simply a concrete boxlike structure, completely enclosed, and containing the necessary valves for head control and washout, which are made accessible through a cast iron manhole door. Water is admitted on the upstream side through a series of three-inch vitrified tiles, which are in turn protected by a filling of rock and gravel. It was originally intended to deposit a considerable quantity of gravel at this point to ensure adequate filtration of the water, but it was found that, after the completion of the dam, the river current itself quickly formed a deposit just where required so that which would have entailed a considerable amount of labor was satisfactorily performed by natural agencies.

Pipeline

The pipeline, which is 16,000 ft. long, is of 8 in. woodstave pipe throughout, with the exception of 240 feet of an inverted syphon where the line crosses the Puntledge River. This section is of 10 in. cast iron pipe, and is laid in a chase cut in the bed of the river. The rock formation at the point chosen for the crossing

Dam and intake chamber of Courtenay, B. C. water supply system. The entire structure is submerged at times of freshet

Looking downstream from the dam on Brown's River, with the intake chamber in the right foreground. The line of pipe is under water at times of freshet. The illustration indicates the nature of the locality through which the pipe line is laid is peculiarly advantageous, being a shale with horizontal cleavage. The river at this point is very shallow and the bottom is waterworn shale without gravel deposits, and without any deep channel or marked irregularities, so that the crossing, while attended with the usual construction difficulties due to the river flow of between 300 and 400 second feet, was greatly facilitated. The upper 1,200 feet of the pipeline from the dam to the point where the line turns out of the river bed has caused some anxiety on account of the difficulty of protecting the pipe from washout during periods of high water. The contractors are principally engaged at the present time in putting the finishing touches on this portion of the work.

The main discharges through a float-controlled valve into a 50,000 gallon concrete balancing reservoir close to the town and at an elevation of about 160 feet, giving an average pressure of 70 lbs. per square inch.

Ten inch cast iron pipe crossing Puntledge River. The pipe is shown laid in a chase in the rock but is not completely concreted

This reservoir is completely enclosed and roofed, and is of reinforced concrete construction throughout. Access to valves is provided through cast iron manhole-covered doors, and the whole is banked and covered with earth to ensure an even low temperature of the water.

From this point the distribution system begins, and consists of wood stave pipe varying from 12 in. down to 4 inch. Fire hydrants are provided at the block corners and contribute to a feeling of security previously unknown in the town, which has on several previous occasions suffered disastrously from fires. House services are of ½ in. galvanized pipe.

Although the system has only recently been put in operation, about 80 services are already installed and it is expected to largely increase this number by the spring. A monthly charge of $2.00 is made for house service, and a scale of flat rates has been arranged to cover the various industrial uses.

Jas. Mercer Explains Contractors' Activities to Hamilton Architects

The recent regular semi-monthly meeting at the Royal Connaught Hotel of the Hamilton Chapter, Ontario Association of Architects, was featured by an address by James F. Mercer, president of the Hamilton Association of Building and Construction Industries. Mr. Mercer first dwelt on the aims of the association of which he is president and pointed out that it was only by a spirit of harmony and co-operation that the architect and the contractor were able to give the client the most efficient service. In outlining the policy of the association, Mr. Mercer said; "The policy of our Hamilton Association is that we are trying for a better understanding with engineers, architects and the building public. We appreciate the fact that the cost of building has in the past been too high, and we are using our utmost endeavor to bring down the cost of building, so that it will again become a profitable field for the investor. We stand for a stabilizing of the building and construction industries. We have an educational plan on our program which endeavors to improve the small operator."

The speaker then took another phase of the work as the subject of his remarks, and with considerable force, and interpersed with some humor, he pointed out how the architects could co-operate with the contractors in bettering the interests of the individual builder and the country as a whole, which he summed up in the following cogent phrases;

"By adopting an attitude of trust and co-operation.

"By being just to the owner, and at the same time fair to the contractor.

"By using a just and fair form of standard contract.

"By specifying Canadian and, if possible, Hamilton-made materials.

"By recognizing and patronizing the responsible and reputable contractors."

At the conclusion of Mr. Mercer's able address, Councillor B. Frank Kelly moved a hearty vote of thanks to the speaker.

Other items of business included the adopting of a resolution endorsing in principle the O'Brian deferred street widening bill, which is to come before the provincial legislature.

William Storrie Heads Toronto Branch of the Engineering Institute

At the annual meeting of the Toronto branch of the Engineering Institute of Canada, held on March 16, committee reports for the year were discussed and officers elected as follows: William Storrie, of Gore, Nasmith and Storrie, chairman; E. G. Hewson, vice-chairman; F. B. Goedike, secretary-treasurer; R. C. Muir, N. D. Wilson and W. A. Duff, committee. Addresses were given by the retiring chairman, George Clark, and by his successor, Mr. Storrie.

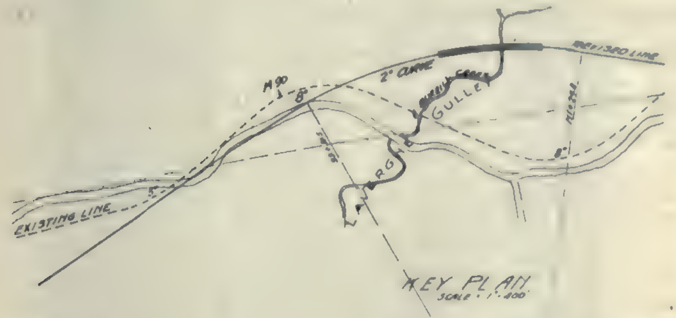
The proceedings of the seventh annual conference on highway engineering, held at the University of Michigan, on February 21 to 25, 1921, have just been published. The papers and discussions will be found of great value and interest to all road engineers and contractors.

Steel Viaduct Eliminates Bad Curves on Canadian National Railway

New Bridge Over East Burrill Creek in St. Maurice County, P.Q.—Deck Plate Girder Structure on Towers—Two-Eight Degree Curves Supplanted by One Two-Degree Curve

The elimination of heavy grades and bad curves on the Canadian National Railways has resulted in the building of numerous fine new bridges and viaducts. the latest of which is the East Burrill viaduct. As shown in the accompanying location plan, this new structure was made necessary by the revised location of the railway over the Lavergne Gulley in the county of St. Maurice, Quebec. The right-of-way previously crossed the creek by two eight-degree curves, which have been replaced by one two-degree curve over the viaduct.

The overall length of the new viaduct is 642 ft. 8 ins. from face of backwalls, on the centre line of the track. It is composed of one 80 ft., two 61 ft., four 60 ft., and five 40 ft. spans, all of the deck plate girder type. There are five viaduct towers and one rocker bent, the forty foot girders being on top of the towers. A plank walkway has been provided on one side of the bridge, every fourth tie being lengthened for this purpose. The total weight of structural steel is 1,020,000 lbs.



East Burrill viaduct on the C.N.Ry. eliminates dangerous curves

Details of Towers

The towers rest on concrete pedestals which are supported by piles. No hard pan or rock was found, but hard sticky blue clay was encountered and the testing rod could not be forced down much more than twenty feet even with the aid of a lever. The tower legs are made in the shape of an H, the two outside flanges being 15 in. I-beams and the web a 12 in. I-beam. The variation in the area of steel required for each bent was taken care of by using different weights of I-beams. On account of the curve, it was necessary to raise the outside rail one and one-half inches above the inner one. This was done by making the outside tower legs longer than the inner ones. The highest tower is seventy feet from the top of the pedestal to the under side of the plate girder.

Expansion points have been provided at the east side of each tower with the exception of the one next the rocker bent, on which two expansion points have been placed, one on each bent of the tower. There is also one on the east abutment. They are composed of bronze plates polished on the sliding surface.

The plate girders are all 7 ft. 0 in. back to back of angles with the exception of the 80 ft. one which is 9 ft. 0 in. The top flange of this girder is composed of two 8 in. by 6 in. by ¾ in. angles, two 6 in. by 6 in. by ¾ in. angles, two side plates, 10 in. by 7/16 in., and two side plates, 10 in. by 3/8 in., making a total gross area of 53 square inches. The bottom flange has two 8 in. by 8 in. by ¾ in. angles and three 18 in. by 9/16

The new bridge over East Burrill creek in the county of St. Maurice, P.Q.

in. cover plates, the web of the girder being 108 in. by 3/8 in. One-sixth of the web area was included in the design of the flanges. The viaduct was designed for Cooper's E 60 loading with 6000 lbs. uniform load.

The east abutment is of the batwing type, twenty-six feet high and made of concrete, while the west one is of temporary timber construction resting on rock fill to be replaced by a permanent concrete abutment when the fill settles.

The superstructure was fabricated and erected by McGregor and McIntyre Ltd., Toronto, Ont., and the design of the whole bridge was executed in the offices of the Canadian National Railways.

Reports Good Prospects

Mr. Miles Lonergan, general contractor of Quebec City, reports work keeping him busy and prospects for spring, especially in road building, as good.

Kiwanians to Help Apprenticeship in the Building Trades

At last week's meeting of the Kiwanis Club, of Toronto, the feature was a brief talk by Mr. W. E. Dillon, of Toronto, on the training of apprentices for the building trades. This is a work that the Kiwanis Club is taking up very vigorously, inasmuch as it is felt that the under privilieged boys that are being cared for by the club should be given a life work as soon as their school period is passed. Mr. Dillon outlined how the Kiwanis Club could be of immense benefit to both the boys and to the building employers in fostering an apprenticeship scheme, giving the boys adequate practical training as well as a schooling at the Technical School.

Mr. George Clapperton, who followed Mr. Dillon, also indicated the general nature of the scheme and outlined the progress to date.

Heavy Rock Excavation at Extension of Johnson St., Victoria

17,000 Cubic Yards in Course of Removal, the Spoil Being Used to Fill in Approach to and Abutment of the Johnson St. Bridge—Work Handled by Steam Shovel and Narrow Gauge Railway

By our Victoria, B.C., correspondent

A contract has recently been let to the Pacific Construction Co. of Vancouver, B. C., by the provincial government, for the rough grading of the part of the Johnson Street which passes through the former Songhees Indian Reserve. This land, as previously reported, (Contract Record, May 4, 1921, page 431) was acquired some years ago by the government by purchase from the Indians for the purpose of developing a modern union railway terminal yard.

As the southern portion of the area, where the bridge is located and where the tracks of the Esquimalt and Nanaimo Railway have crossed for many years, is largely rock with quite sharp grades, the excavation work is very heavy for the whole of this portion of the scheme, and the grading of Johnson Street is no exception, as the accompanying photograph shows.

There is an estimated quantity of 17,000 cubic yards of solid rock in the present contract, which the Pacific Construction Co. have taken at the figure of $45,378.00. This figure, however, includes a certain amount of finishing work, and the forming of the road east and west of the big cut with material taken from the excavation. A large amount of the rock excavated will also be used for the filling of the west abutment of the bridge, which was shown completed as to concrete work in a picture accompanying a recent article, (Contract Record, Feb. 8, 1922, page 129) and another large percentage of the total quantity will be used for the approaches at the west end, which rise from the undercrossing of the railway tracks to the bridge floor level at a grade of about 4 per cent.

This is the second large job which the Pacific Construction Co. have been successful recently in landing at Victoria, they being the subcontractors for excavation and concrete on the Dominion Government 1,100 foot dry-dock now under construction at Esquimalt Harbour four miles from Victoria.

A commencement on the work has been hastened as a measure of relief for unemployment in the Victoria district, and a considerable number of men are now finding work on the job. The work is being efficiently handled by the contractors, however, who have a steam-shovel working and loading the broken rock into dump cars which are handled to the west abutment of the bridge, where all the spoil is at this stage being dumped, by a dinkie engine. Tracks are the usual narrow-gauge, and are kept advanced right up to the shovel. The haul at present is about 1,200 feet, and will probably increase to as much as 2,000 feet as the work progresses.

Grading in rock cut for Johnson St. extension, Victoria, B.C. There are 17,000 cu. yds. involved in the contract

Value of Underground Topography

Experience in Sewer Construction Indicates the Necessity of Securing a Good Working Knowledge of Conditions Below the Surface—Charts for Reference Purposes

By W. G. CAMERON
Assistant Engineer, Sewer Section, Works Department, City of Toronto

In most cases it is found necessary, before an engineer begins the design of any large utility, to have or ascertain the topography of the land and take borings to make sure of that which lies beneath. But, is he always sure? In an undertaking covering a small area, he likely is, but where the utility covers a large area, as for example, several city blocks, he can never be sure. Sometimes the ground will change in a few feet. In many instances I have observed that this has been the case. In one example, a shaft was sunk for a tunnel and mining was proceeded with in two opposite directions. The ground was quite dry, but work had only proceeded about 10 ft. in one direction and 50 ft. in the other, when a fluid mixture was encountered (Fig. 1) and operations had to be suspended temporarily until other means of doing the work could be secured. Compressed air was finally used. In another case, work was progressing in a tunnel in dry sand when wet sand was met with. Cap and leg timbering was being used and although a mud sill was employed, the overhead pressure was great enough to force the legs several feet into the ground. (See Fig. 2).

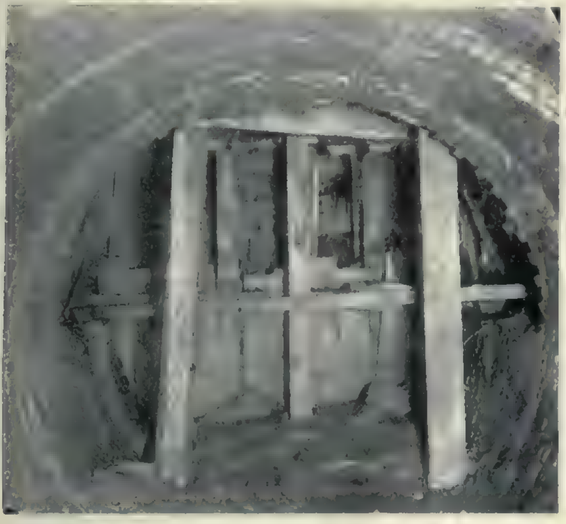


Fig. 1—Wet soil is often encountered when working in the dry, necessitating a revision of the method of operating

Rapid Changes in Conditions

In still another case, a shaft was sunk in dry ground and work had proceeded a considerable distance when, on entering the work one morning, the workmen found to their dismay the tunnel half full of water. The water had seeped in over night through a sand seam. This seam followed the work for the remainder of the job. It was narrow at first, gradually widening out until it was several feet in thickness and later turning to a very wet mixture of clay and sand. (Compressed air had to be resorted to). On the other side of the shaft, the ground, although clay loam at first, changed rapidly from clay to sand, fine gravel, coarse gravel and then hard clay. This sand and gravel carried much water. One block away the ground was a hard dry clay which had to be removed by blasting. This clay contained at the elevation of the tunnel (30 ft. from the surface) small branches of trees. There had evidently, in bygone days or past ages, been a creek through this part of the land, which had long since been filled in, either by natural or artificial means. The old banks were, no doubt, sedimentary, as evidenced by the branches.

In many other cases which could be mentioned, similar rapid changes could be cited both in open cut near the surface and in tunnel far beneath it. Generally, in cases where bad conditions are met with, compressed air is used, and in one such case recently, a curious thing happened. A bidder had put down a boring to test the condition of the ground and later, when the tunnel, in which compressed air was used, was passing the boring, the air, following a seam the boring had tapped, forced water up through it in such quantity as to give the appearance of a large fountain. This unusual sight attracted the attention of many people some of whom called out the fire and water service men, thinking a water main had burst.

Necessity of a Knowledge of Underground Conditions

These cases cited above only tend to impress one with the necessity of securing a good working knowledge of the underground topography as well as of that of the surface, and it is suggested that in large centres where records are kept, charts showing underground conditions be compiled. In many cases these would have to be made from borings, for, as a centre grows, all uneven places are removed either by excavating or filling in and where filled, care is seldom taken to do the work with the future in view. It is quite possible to leave conditions which may later give trouble. For example, a basement

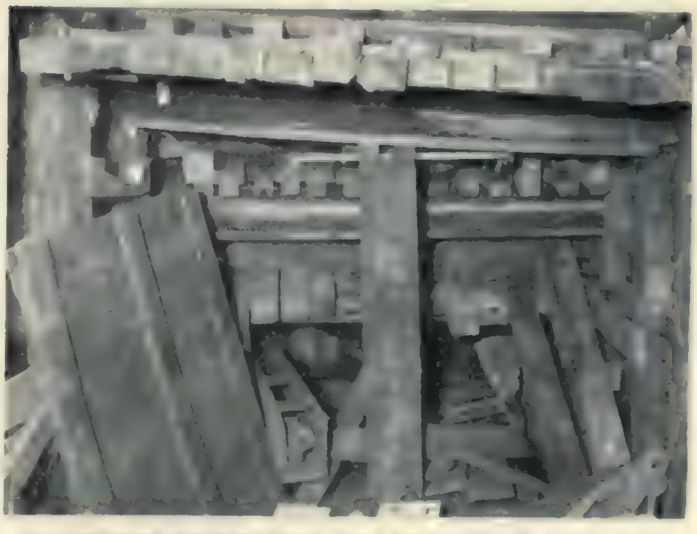


Fig. 2—Tunnel timbering forced down by pressure of wet sand above

opposite a place where compressed air was being used was flooded and on investigation, a well was found which evidently tapped the seam containing the water that occasioned the necessity of compressed air in the tunnel. The air following along the seam forced the water up through the well, which had been carelessly filled, and flooded the basement.

It seems likely that the most useful form in which to embody this information would be charts showing the present contours and the outline of the present streams and all depressions. Different colored inks or other devices could be used to map underground conditions ascertained from borings, shafts, tunnels and other means. Even memory could be used to glean information if found advisable. These maps or charts should prove invaluable when any utility is to be built in any locality where this information has been assembled. Provision should also be made for constant additions and corrections to these charts as new utilities are constructed and new information gleaned. In this manner, we would know where old depressions existed and with what they had been filled, where old watercourses existed and whether they had been filled naturally or artificially, their depth and present state, old wells, crossings, roads and services of all kinds not formerly charted in the days before records were kept.

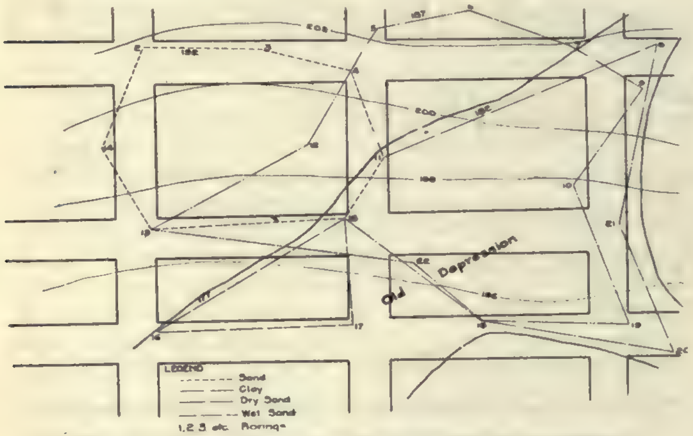


Fig. 3—A typical chart describing underground conditions

In some large centres, the necessity for such charts would not be as pressing as in others. This will depend largely upon the original natural layout of the site, for in some cases it is solid rock, in others it is loam of different grades, or the conditions may vary from the best to the worst where the site is largely quicksand. In the latter cases, if these conditions existed by themselves, our problems would not be difficult, but after the fashion of nature, such conditions seldom exist alone.

Variation in Soils

We have all known streams, from our youth up, that have changed their courses, and when we consider that these changes may have been going on for ages, we can easily see what great variations in conditions might have been produced. Let us consider the modern sand-sucker filling in a piece of low lying sand. The stream which winds towards the lowest point carries much sediment with it, which deposits in the most convenient place. Very often the stream changes its course, sometimes for no apparent reason and other times on account of this deposit, or if in winter, it may be blocked by ice and so changed. The old course gradually fills up by silt, drift, or other causes. From this modern example we can easily see how that, in the days gone by, a stream following its usual course gradually or suddenly was blocked and had to find a new channel. Perhaps it had to cut through a clay bank or it may be sand and gravel. It carries this material along a certain distance and then deposits it. Perhaps the stream was a glacial one and then we have glacial drift being deposited. It is quite apparent from this that in the sites of our town and cities, we have all kinds of land composed of clay, sand, gravel and large stones and mixtures of these, either in drifts or horizontal strata. Generally, when the ground is laid down in strata, we get water in the layer of sand and the pressure or head may be greater than the depth will indicate, as it probably follows along a slope under an impervious seam for a greater or less distance, or it probably will be altered by any of many natural causes. In some cases, if the correct cementing materials are present, we will get a layer of sand turning to stone. We will, at any rate, find many conditions in the progress of the work which could easily be recorded for future reference.

Penalties for Unions Disobeying Jurisdictional Awards

At Washington, D. C., Meeting, Action Was Taken to Make Workmen Abide by Decisions of National Board

The Associated General Contractors of America, the American Institute of Architects, the Engineering Council, the National Building Trades Employers Association, and the Building Trades Department of the American Federation of Labor, through the National Board for Jurisdictional Awards, which has just concluded its regular quarterly meeting in Washington, D. C., have reached a national agreement through a resolution heavily penalizing union workmen who refuse to abide by the decisions of the Board.

The resolution provides that local building trade councils of union labor shall suspend unions and refuse to recognize or support those unions which refuse to abide by decisions of the National Board; it also provides that general contractors and subcontractors who employ only union labor shall incorporate in their agreements with labor a provision that will secure compliance with all the decisions of the Board and that they shall refuse employment to members of local unions which do not abide by such decisions and further that architects and engineers shall insert in all their specifications and contracts a clause that such decisions shall be followed.

This resolution is of far reaching consequence to settle these jurisdictional disputes, which in the past have constituted the majority of the causes for strikes and resulting delays and economic losses.

It is the most effective co-operation between workmen, employers, and professional men interested in construction looking toward the settlement of these jurisdictional disputes without resort to strikes.

Action Directed at the Carpenters

This action has been taken as the result of the report of a special committee of the National Board appointed to outline the procedure to be followed in clearing up the situation created by the refusal of the United Brotherhood of Carpenters and Joiners to conform to the decisions of the Board in the case of settling the dispute between the carpenters and the sheet metal workers which was decided in favor of the latter. This dispute involved the setting of sheet metal trim on doors and windows. The carpenters have refused to abide by the decisions and have called strikes and suspended work on big construction jobs in many parts of the country causing serious trouble and unemployment in other trades.

The resolution follows:

Whereas, the United Brotherhood of Carpenters and Joiners of America has not been observing or conforming to the decisions of the National Board of Jurisdictional Awards in the Building Industry; and

Whereas, the attitude of that organization in failing to observe those decisions is seriously embarrassing owners, architects, engineers, contractors and workmen engaged in the building industry, and such a condition tends to increase costs and to cause delay and is detrimental to the public interest and the building industry in general; and

Whereas, all parties signatory to the plan of the Jurisdictional Board have been actively supporting the decisions of that Board, including sixteen of the seventeen International Unions constituting the Building Trades Department at the inception of the Board;

Resolved, that in order to correct the above mentioned conditions, the several signatories to the plan of this Board be urged to instruct their constituent members, each in its respective field as follows:

That the members of the American Institute of Architects and of the Federated American Engineering Societies insert in all specifications and contracts for building operations a stipulation that the decisions of the Jurisdictional Board shall be observed;

Compliance with Jurisdictional Decisions

That the members of the Associated General Contractors and of the National Association of Building Trades Employers incorporate in their agreements with their sub-contractors a provision that will secure a compliance with all decisions of the Jurisdictional Board and that the members thereof shall refuse employment to any local union or members thereof neglecting or refusing to abide by decisions of the Jurisdictional Board;

That the Building Trades Department shall instruct local councils to unseat any local union refusing compliance with such decisions, and that associated International Unions shall instruct their respective locals to extend neither recognition nor support until such time as delinquent locals accept and abide by all decisions of the Jurisdictional Board;

Resolved further, that this resolution shall be enforced as expeditiously as possible beginning with those localities in which the trouble appears to be most acute and where action seems most urgent, and that all these signatories make special and united efforts toward securing general and complete compliance with all the decisions of the Jurisdictional Board; and

Resolved also, that as and when trouble in any locality is brought to the attention of any of the signatories such organization shall take the initiative in forming a general committee of representatives from all the signatories for the purpose of dealing with the situation in that locality.

Of the seventeen international unions that constitute the Building Trades Department of the A. F. of L., sixteen have unqualifiedly endorsed the work of the Board and supported its decisions. The carpenters' union alone, although one of the original organizers of the Board, now refuse to support it. As a result they have been suspended from the Building Trades Department of the American Federation of Labor, and been outlawed by every building trade council, and the leading organizations of general contractors, sub-contractors, engineers and architects in the country.

The purposes of this national board for jurisdictional awards is to settle difficulties between unions over what crafts shall do certain work in the construction industry by orderly and judicial procedure rather than by costly strikes. The metal trim case above referred to was under construction for nearly a year during which both sides were given ample opportunity to be heard. Fifty decisions of nation-wide scope have been rendered in the past two years, and these decisions have settled or averted over 200 strikes in 1921.

An important decision also finally settled at the recent meeting of the Board was that of the elevator constructors vs. the electrical workers as to which trade should have jurisdiction over the work of hoisting, lowering and placing of elevator machinery. The work was awarded to the elevator constructors, and the international presidents of both unions state their mutual willingness to abide by the decision issued by the Board.

Patching Concrete

In patching shallow holes in concrete sidewalks, walls, etc., I have found it better to use lime water instead of plain water. Take as much lime as is considered necessary and slake it in enough water for the job on hand. Allow most of the lime residue to settle before decanting the lime water. Remove all particles of loose dirt, concrete, etc., from the hole to be patched and then wet it thoroughly with the lime-water. Work it to a plastic consistency and then apply it to the hole to be patched. I have found that using lime water gives a more substantial and durable patch.—Carl A. Soderstrom, Denver, Colo., in "Concrete."

Trade Incorporations

Winnipeg Sand & Gravel Co. Limited, with head office at Winnipeg, capital $150,000, to deal in stone, sand, gravel and clay products.

Bernard Brault, Ltd., with head office at Montreal, capital $300,000, to carry on the business of general contractors and supply men.

O. A. Cole, Limited, with head office at Toronto, capital $50,000, to carry on the business of contractors and supply men.

Ontaria Farmers Drainage Co. Ltd., with head office at Toronto, capital $600,000, to carry on the business of drainage contractors.

McArthur Engineering & Construction Co. Ltd., with head office at Guelph, capital $100,000, to carry on the business of civil engineers and contractors.

In our issue of March 8 we stated that Ed. Belanger had secured the contract for carpentry and masonry work on Lagueux School, Quebec City. This was an error, as this contract is held by Magloire Cauchon.

Problems in Constructing First-Class Concrete Road Surfaces

The Surface Is the Important Thing—Frost Action Minimized by Keeping the Sub-grade Dry—Eliminating Expansion Trouble—Importance of Clean and Uniform Aggregates

By L. A. PARDO

County Road Superintendent, Kent County, Ont.

Before Conference of County Road Superintendents and Engineers of Ontario

During the past few years a great deal of study has been given to the construction and maintenance of concrete roads, and many splendid articles have appeared in our journals from time to time, so that it does not seem probable that anyone can add much new subject matter of interest. I am, therefore, only attempting to review the situation as I find it, dealing as closely as possible with the various factors that function for and against the construction and maintenance of an intact and smooth riding concrete surface on highways.

As soon as we are able to build such a road, of modern and improved design, the surface of which remains intact and smooth throughout its life of twenty years, then we have reached a stage of skill in that particular form of construction almost beyond criticism, regardless of the method adopted in its construction, for after all is it not the surface we are after? It is the surface we see, look at, examine and use and from its appearance we dare to judge much. If we find it in a state of perfection we must be satisfied, for the object of our efforts has been attained.

Such a condition, however, is seldom found, and if we want it we must consider carefully the various factors that work against it and finally a practical method of eliminating them. My remarks are mostly applicable to the construction of concrete roads in suburban areas and particularly applicable to the conditions found in the county of Kent, where the soil is mostly a heavy plastic clay, the country very flat and the ground water level, which is controlled by the adjacent rivers and lakes, about six feet from the surface.

Local Climatic Conditions

In a country where temperature varies over one hundred degrees, great stresses must be expected and the destructive work of this powerful agent is plainly observed not only in every piece of construction for which man is responsible but in our rugged mountains and on our rocky shores. If a concrete pavement is so constructed that it absorbs any appreciable amount of moisture, subsequent cold weather will cause sufficient expansion to loosen pebbles and minute particles at the surface. These are later whipped out of place by the wind or passing vehicles, thus providing greater facilities for this agent to carry on its work which, although comparatively slow, is very persistent and certain to produce holes of various sizes on the surface. It, therefore, seems that every effort should be made in the interest of permanency to produce at the surface a concrete that will absorb a minimum amount of moisture.

It is equally important, in the interest of a smooth surface, that good drainage should be provided so as to reduce as much as possible the percentage of expansion in the ground, beneath the pavement and and in the shoulders. Water expands ten per cent. in freezing. Perfectly dry earth would not show any appreciable effect from frost at all, but such conditions cannot be found or expected, so that the rate of expansion in our coldest weather lies between zero and ten per cent. and the nearer it approaches zero, the ideal condition, the less will be the disturbance in the foundation of the concrete road. It has been observed that cracks occur usually when the frost is going out of the ground in spring and not during the period of freezing, or in other words, when the ground is contracting under the pavement. This would suggest to us that during the period of expansion which is usually gradual the expansion was downward or toward the sides, owing to the weight and great strength of the slabs. When the thawing process begins, subgrade and pavement, in obedience to the law of gravity, settle downward, and natural beams form in the subgrade on account of its varying compactness, producing cracks which open on the surface and admit more moisture if not properly repaired. Once this natural adjustment has been made, future changes are usually slow to occur, provided the conditions with regard to the drainage and moisture are constant.

Subgrade of Uniform Compactness

The explanation of this subgrade movement during the first twelve months and its comparative inactiveness thereafter requires some investigation. The majority of breaks that occur in the surface of pavements are due to foundation movements, and not expansion within the concrete itself. I am of the opinion that a critical analysis of any subgrade for a depth of four or five feet below the surface would reveal a great variation every few feet in compactness, density and porosity; consequently, when the action of frost begins, its intensity will vary in accordance with those conditions, producing a network of beams and these conditions obtain once the adjustment is made so long as conditions of drainage remain unchanged. It would seem then that a subgrade of uniform compactness is very essential and that can only be attained by breaking up the roadway to some depth below the proposed subgrade, level, disturbing as much as possible all natural arches and pockets formed through ages and earlier construction, and finally recompacting the same by proper rolling.

The climatic conditions of Canada are rather extreme and they present to the canadian engineer and road builder problems not considered in many parts of the world. The moderate climate of the British Isles is conducive to successful good road construction and particularly their low cost of maintenance considering the amount of traffic. Again, the topography of the county is such as to permit excellent drainage.

Dry Subgrade Desirable

Good drainage should be provided to the subgrade of any pavement in a locality where a freezing temperature obtains for any length of time sufficient to penetrate it. Some soils have natural drainage, and in some localities the natural ground water level is many feet below the surface and some soils are quite impervious, offering almost complete resistance to the transfer of water from the surface to points deeper down where it will not freeze. Some soils absorb a great amount of water and like our heavy clay, soils become spongy and plastic. Owing to the uniform support which the subgrade is intended to give to the concrete slab, surely we cannot afford to allow it to saturate and freeze—a process that would be most destructive. Almost all specifications for the construction of large engineering work require that foundations go below the frost and that concrete must not be deposited on frozen ground. In the construction of highways, we can eliminate the latter but we cannot go below the frost line for our foundation; consequently, our attention should be turned to some practical means of preventing the subgrade from freezing. How can it be done? It is my opinion that the subgrade must be dry, or as free as possible from moisture without which the action of freezing temperature is not much to be feared. The various methods of providing drainage are somewhat beyond the scope of this paper but it has been introduced to suggest how poor drainage, in co-operation with cold weather, may be held responsible for the majority of cracks and settled joints almost invariably found on our concrete roads.

It is difficult to prevent deterioration caused by expansion alone. Elastic joints are inserted at intervals of from thirty to fifty feet in accordance with various specifications and practice but the fact that most damage to concrete surfaces on account of expansion occur at the joints has led many cities and suburban districts in Canada and the United States to abandon their use, except when a joint is made at noon and at night or any other time when pouring operations cease for longer than thirty minutes. However, in a climate such as this it is difficult to believe that the joint is not of some use in saving the pavement from the destructive effect of expansion.

Uniform Aggregate

If we wish to obtain a smooth riding pavement we must pay some attention to the uniform quality of the aggregate, that is, so far as specific gravity, wear and toughness is concerned. It is generally admitted that a certain amount of separation unavoidably occurs when the batch is deposited although we talk preventing it in various ways. It is also a known fact that the softest rocks are the lightest and if sufficient agitation is provided during the finishing operations it is natural to expect that the materials will arrange themselves in the mass in accordance with their specific gravity, that is, with the softest on the surface and with the degree of hardness increasing towards the bottom. Such an arrangement of aggregate would favor absorbtion of water, aiding the action of frost and wear. Many gravel pits contain an aggregate in which there is a high percentage of stone that can be ground up with ease; this may be expected to cause uneven wear which in turn would increase impact from traffic and further destruction to the surface, giving a rough riding and rough appearing pavement.

Ball Engine Co. Changes Name to Erie Steam Shovel Co.

The Ball Engine Co. of Erie Pa., makers of the well known Erie steam shovel, have changed the name of the company to the Erie Steam Shovel Co. This change has been made because of the fact that the undivided capital, energy, and full plant capacity are now devoted exclusively to the production of Erie steam shovels and cranes, the engine business having been sold to permit the company's entire manufacturing facilities to be used for building steam shovels and cranes.

Even in face of the discontinuance of the manufacture of the well known "Ball" steam engines for power plant use about two years ago, it has been necessary to more than triple the plant capacity in the past six years to take care of shovel and crane business. This enlarged plant is now running day and night with full force on each shift.

There has been no change whatever in the assets, policies, management or personnel of the Ball Engine Company--the change is in name only, to provide a corporate title more in keeping with the present exclusive activities.

Plant of the Erie Steam Shovel Co., Erie, Pa. (Formerly Ball Engine Co.)

Although the capacity of this plant has been tripled within the last six years, it is running day and night to keep up with the orders for Erie steam shovels and locomotive cranes

Modern Road Building Machinery

Descriptions of the Equipment That is Now Considered Necessary for the Construction and Maintenance of Highways—Hand Methods Have Little Use in Modern Road Building Operations

By E. H. BECK, C.E., A.M.E.I.C.

Continued from last issue

The Scarifier

This machine is possibly the most difficult machine to design in order to give successful results, owing to the enormous strain which has to be withstood in the work demanded of it.

Figure 6* shows a good type of scarifier, being constructed of an exceptionally strong low level frame from which is hung the 5 or 9 cutting picks, so arranged as to be capable of an adjustment for depth.

Scarifying attachments are also supplied for use on the road graders, replacing the blades on those machines. In each case, the separate picks can be replaced easily when worn or they can be removed for sharpening.

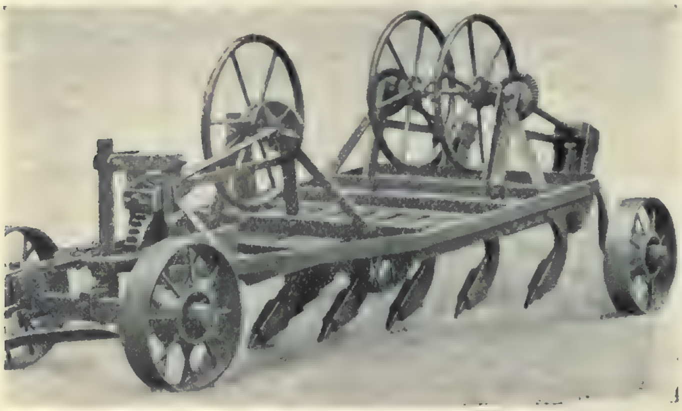


Fig. 6—A road scarifier

Possibly the most effective scarifier is that attached to and operated by a steam roller, which will be referred to below.

The Road Maintainer

In Figure 7 is shown one of the latest types of road maintenance machines, built on the grader principle, but in place of the blade being in one piece there are four units attached to one another and hung so as to give a flexible blade of about seventeen feet in length, set at a 40 degree angle and giving a full 13 feet 8 inches cutting width. The whole blade is worked by a system of five levers operating at the joints and outside ends of the units. Thus the operator is enabled to arrange his blade so as to shape the crown of the road or he can put the side blade at the steeper angle necessary to form the shoulder or ditch as required, the outside blade easily taking a two to one slope, the rear wheel being well in on the solid roadway.

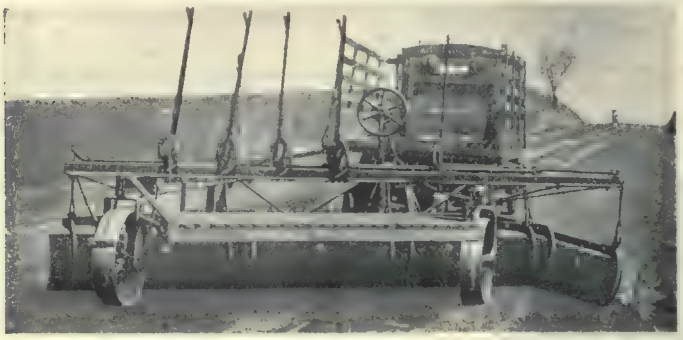


Fig. 7—Road maintainer

Although these machines are termed "maintainers," they are capable of doing very heavy work and are used extensively in the construction as well as the maintenance of roadways. They are supplied for use with either horses or tractor, a special steering device being required with the latter, as explained in the remarks under graders.

The Spreader

A source of no little worry to the road builder is the method to be adopted in spreading the surfacing material on gravel or macadam roads. The old method of dumping a load and spreading by hand has many faults; chief among them (aside from the expense) being the fact that it causes hard and soft spots. Crushed stone especially, causes hard places at each dumping spot on the road, owing to the weight of the pile packing the stone at the bottom, which, of course, simply stays in place, whereas the top portion is raked loosely into position.

The spreading wagon is an improvement and is practically an ordinary dump wagon with the doors running across the wagon in place of longitudinally, and so arranged as to enable their being opened to any desired width, thus allowing the material to flow out at any desired speed while the wagon is in motion.

When using motor trucks, however, the machine which produces the best results is that shown in Fig. 8. It is simply a long receptacle with a "V" shaped cross section having an opening at the bottom and mounted on rollers. The box is attached by chains to the rear axle of the truck in such a position that the truck in dumping deposits the material directly into it, the box being, by means of the rollers, kept at the height required in order to give the thickness of the material called for. The material flows out of the bottom only when the machine is in motion, the box, owing to the "V" shaped principle, being held down by the weight of the material itself; and by means of the two wing blades, regulated for height from the ground according to requirements, the material is spread uniformly throughout.

This method of spreading is by far the best yet devised, as the spreader is easily attached or detached, and can be used by the several trucks successively as they arrive at the site. This is very simple in construction, and in addition to the labor saving feature, undoubtedly assures an accurate depth, saving the material too heavy a layer.

The Road Roller

As the road roller has possibly received more attention and is better understood by the majority of

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*The figures follow consecutively upon those of the last article.

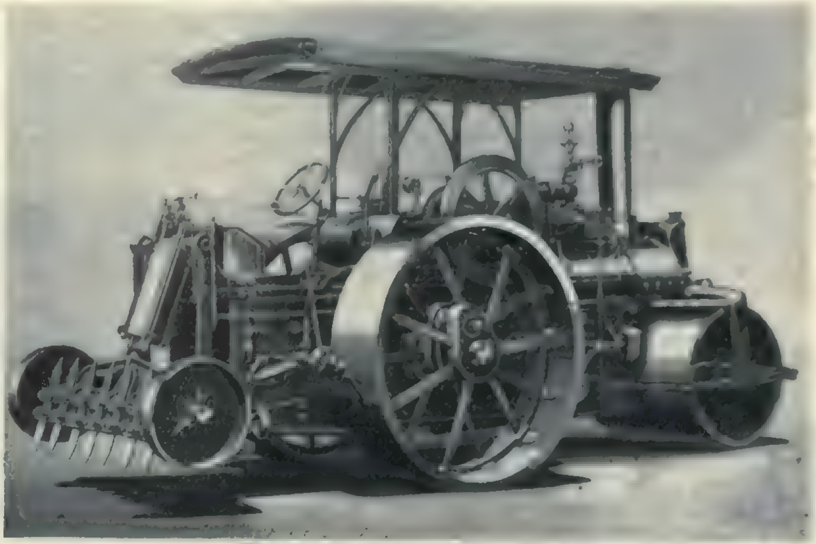


Fig. 9—A typical road roller. This model is fitted with a steam operated scarifier, one man operating both the roller and scarifier.

road builders than the machines enumerated above, the writer will not dwell long on this machine. Fig. 9 is a typical modern road roller which is usually built in 10, 12 and 15-ton sizes, and with a rolling width of 80 to 88 inches. The build is usually high and narrow in order to increase the compression effect but should be arranged that the centre of gravity is carried extremely low in order to prevent overturning. A good point in a road roller is a slight bevel on the face of the rear rolls which helps considerably when rolling the crown of the road. The machine should have two speeds to enable the roller to be moved rapidly when "puddling" and rolling the finishing course and slowly when rolling sub-grade, etc., with plenty of reserve power.

This machine is incomplete, however, without the steam pressure scarifier attached, as shown in Fig. 9. This method of scarifying is no doubt the most efficient on the market today, one man operating both roller and scarifier. The latter is held up out of the way when not in use. It scarifies approximately six feet in width at the regular working speed of the roller.

Figure 10 shows an up-to-date oil distributing machine used in applying light oils and tar products under pressure. A very light oil soon evaporates and

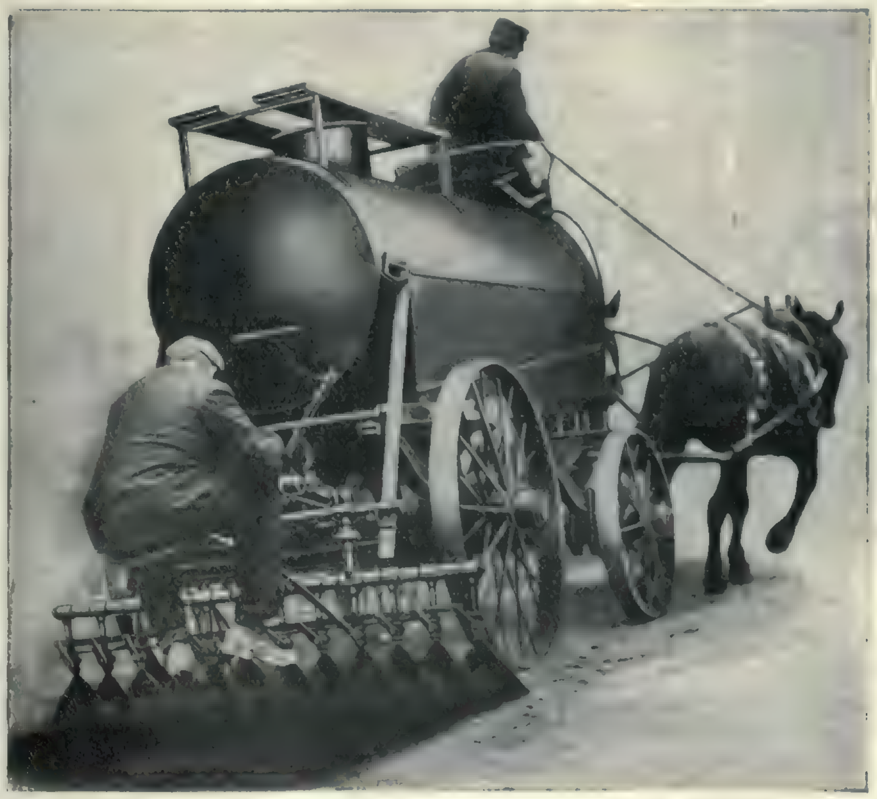


Fig. 10—An oil distributing machine for applying oils and tar products under pressure. A heating device permits medium heavy oils to be distributed

is usually simply spread over the surface of the road. By means of the pressure distributor, shown herewith, even the medium heavy tar products can be employed, as the distributor is equipped with a heating device consisting of a fire box designed to burn wood or oil (the latter carried in a tank at the rear) and especially arranged flue spaces and smoke tube so situated as to furnish additional heating area. The distributing attachment consists of a series of pipes, a distributing manifold and a rotary hydraulic pump located directly in the discharge line from the tank. Power for operating the pump is furnished by means of a sprocket wheel bolted to the spokes on the rear wheel of the truck. The controlling valves and pressure gauges are placed directly in front of and within easy reach of the operator. There are twelve leaders, at the end of each being a positive acting valve controlling the flow of the nozzles. These valves are operated in sets of four by means of two levers, each set operated separately or in unison with the other sets by either lever. In this way strips of ordinary roadway either two or four feet wide can be spread from side to side of the wagon, or one strip six feet wide can be laid. The placing of the nozzles at the lower end of the valves insures the immediate stopping of the flow of material when the valves are shut off; this feature is of special value when the distributor is used on streets where cross walks are frequent as it is possible to keep these walks entirely free from oil. Packed movable joints allow the manifold to be easily swung to either side to counteract irregular driving, without the danger of leakage in the piping, at the same time keeping the nozzles at a uniform height from the roadway. Further, the twin construction of the manifold allows either of the two sections to turn on the joint in case of its hitting an obstruction, thus avoiding breakage.

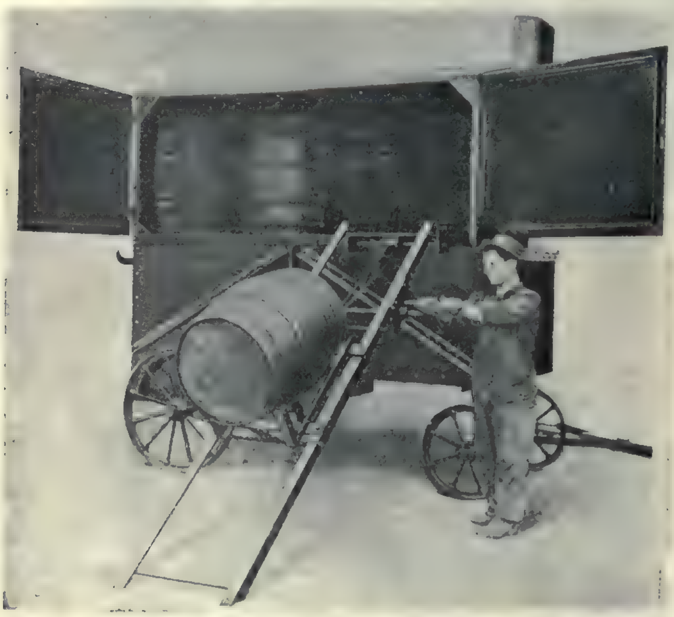


Fig. 11—A combination heating kettle, warming hood and loading skids

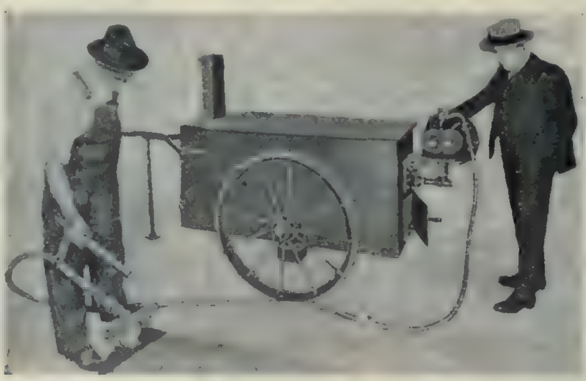


Fig. 12—A small kettle for repair work

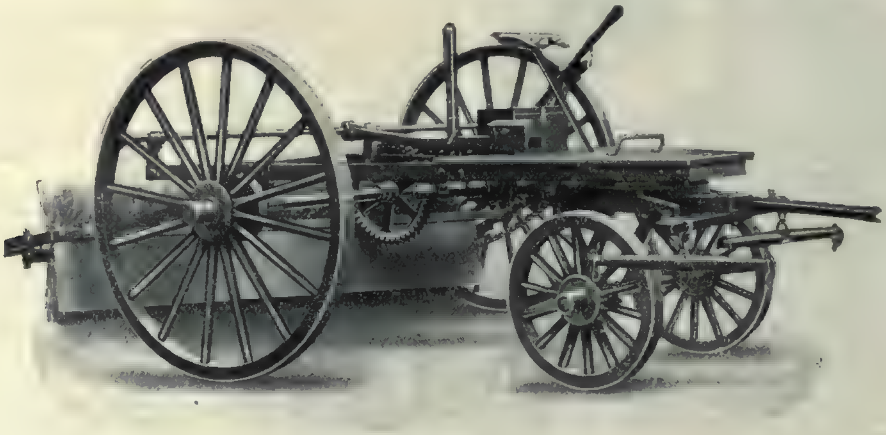


Fig. 13—Two-horse sweeper

The pump's location in the discharge line does away with any pressure in the tank itself. By means of a shaft lever the gears can be thrown in or out of mesh, thus generating pressure only when needed The pressure can also be regulated by means of a valve situated in a by-pass line around the pump. The design of the nozzles gives a fan-shaped stream eight inches in width, and can be developed in a eight inch fall. The number and spacing of nozzles can be arranged to suit the requirements demanded by the work to be performed.

Portable Heating Kettles

In the work of heating heavy bituminious materials the portable heating kettle is invaluable. Figure 11 shows a combination of heating kettle, warming hood and loading skids, forming a very complete and useful heating plant. The barrels are drawn up the skids by means of a windlass and the material can be dropped directly from the warming hood into the kettle.

Figure 12 gives another type of kettle for use on repairs or small jobs and is equipped with pressure pump, hose and nozzles.

The hand pouring pot is another useful article for use with the kettles and is made of galvanized iron with a spreading spout, eight or ten inches wide, adjustable to any size opening from half inch downward.

The Street Sweeper

Figures 13 and 14 give the reader an idea of both the one-horse and two-horse sweepers, which are greatly in demand in preparing and completing the top surfacing of our roadways and pavements.

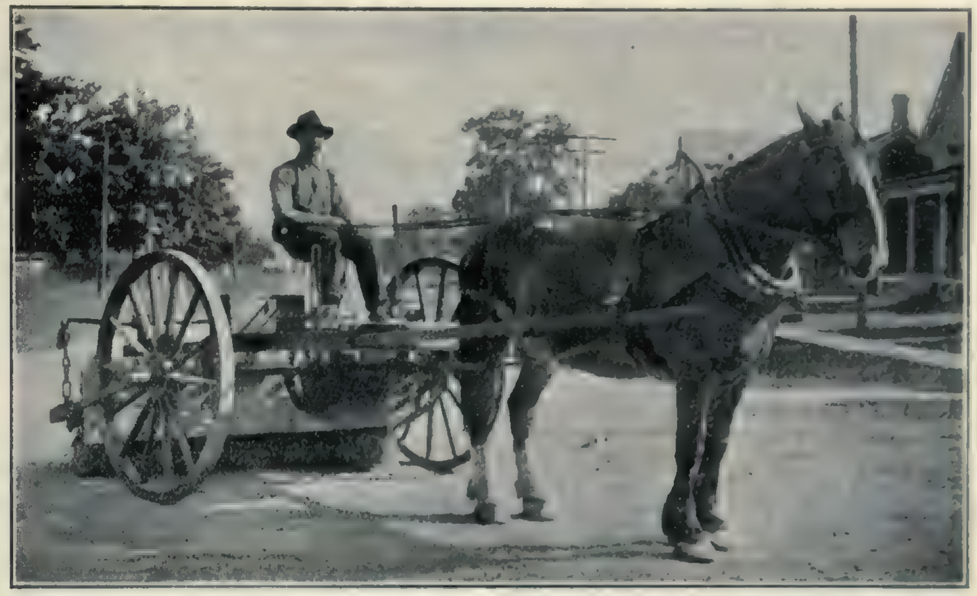


Fig. 14—One-horse sweeper

In the two-horse sweeper the broom is 9 feet in length with a diameter of 28 inches, operated at an angle which gives a sweeping width of about 7 feet. The revolving power is transmitted from the wheels by means of a chain and sprocket to the broom, which is made reversible, and pressure on the broom being regulated, it is thereby worn parallel until completely worn out, when the core can be sent to the manufacturers and refilled at a very low cost. The driver can raise, lower, stop or start the broom without stopping the horses.

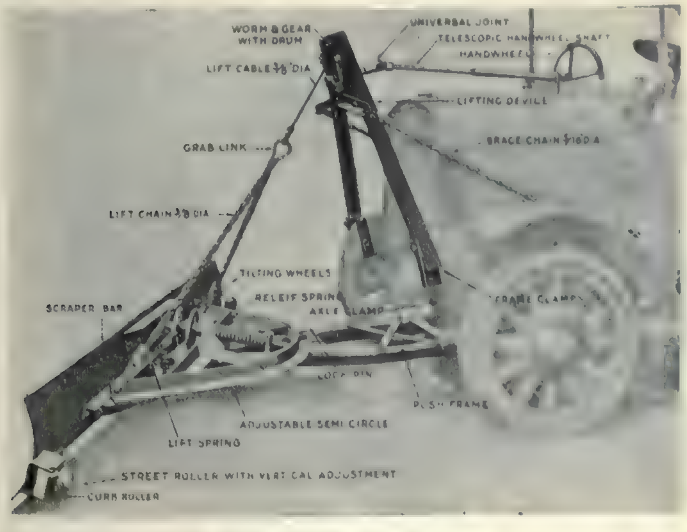


Fig. 15—Snow plough attachment

Snow Removing Equipment

Although this equipment really comes under a different heading than that of road making machinery it is often needed in order to keep the roads open for motor trucks, etc. during the late fall and early spring.

Snow Plow Attachment

Figure 15 shows possibly the most serviceable device on the market today and is being used very extensively in our cities. It is a simple attachment for use on the front of a motor truck and can be attached to any design or make of truck. It consists of a blade similar to that of a road grader, 10 feet long and 16 inches wide, hung to an adjustable semi-circle, pivoted on a push frame which is attached to the front axle of a motor truck. The push frame is supported by chains and a cable leading to a drum on an "A" frame fixed in front of the hood of the truck. The drum is operated from the cab by means of a wheel and shaft, in which is a universal joint, thus making a very flexible operation and enabling the frame to sit at any angle according to the design of truck. By means of a relief spring the blade tilts and passes over any hard obstruction. It can be adjusted to any height or placed at any angle either to right or left and runs on rollers, the sides being protected by curb roller also. By means of a special clamping device or chain hitch, the push frame, circle and blade can easily and quickly be detached when not needed, leaving the "A" frame in position, but not in any way interfering with the operation of the truck for other purposes. In fact the "A" frame can often be utilized as a light hoisting crane if required as such.

A report on the development of the water resources of the Mahoning River including steam control for sanitary purposes and for water supply, prepared for the Mayor and City Council of the city of Warren, Ohio, by Alexander Potter, Consulting Engineer, 50 Church Street, New York City, has been printed in book form and may be obtained from the Warren Printing Company, Warren, Ohio.

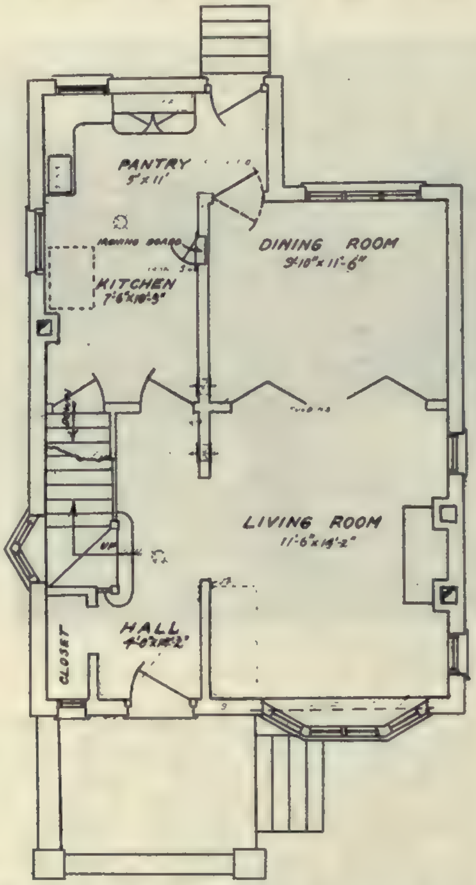
The Contract Record's

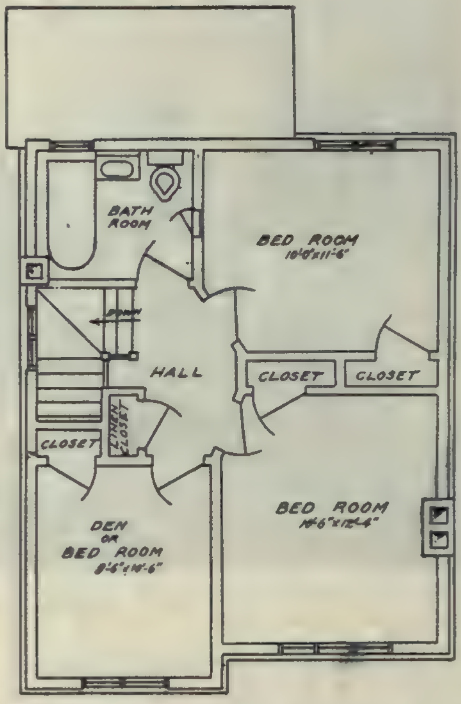
Weekly House Suggestion No. 14

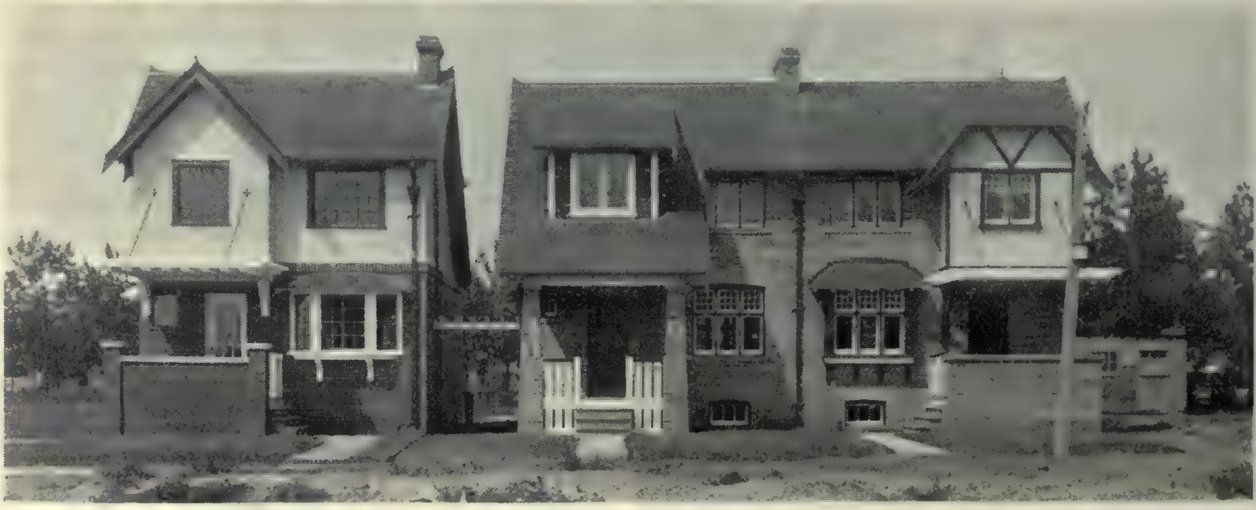
For complete details see the article commencing on the opposite page

The three houses illustrated herewith, although similar with regard to the layout of interior, have each a distinct exterior treatment. The single residence is constructed of Oriental face brick at the front, to the first storey, with stucco above, the stucco work being carried out on all four walls of the first storey. The two side walls and the rear wall to the first storey are of grey stock brick. The front exterior of the semi-detached houses, however, is almost entirely of Oriental face brick, stucco work being carried out around windows only, as seen in the illustration, while as in the case of the single residence, grey stock brick, is used for side and rear walls.

Special attention was given to the minimizing of hall space in the ground floor layout, allowing every foot of space available for the three rooms on this floor. Although no cost elaborations were introduced in the interior construction of any of these houses, every convenience and comfort is provided for.







Careful Attention to Details in Popular Sized Houses in Toronto

An Attempt to Give Distinctive Architectural Treatment, Superior Construction and a Roomy Layout—The Design Involves Unique Features, Including Steel Sash

By R. G. SAUNDERS
Of Weddell and Saunders, Toronto

In the fall of 1920 considerable comment was made in the press and elsewhere concerning the type of dwellings which were needed to meet popular demand and satisfy the ever increasing housing problem in the city of Toronto. The consensus of opinion was to the effect that the right type of building was not being erected for the man of moderate means, who desired a home and who was not interested in merely a speculative venture.

There appeared to be no half way measure, for on the one hand, there were properties for sale of the higher values from $10,000.00 upward, the carrying charges of which were alone excessive to many, while on the other hand, speculative builders were erecting dwellings varying from $3,500 to $5,500 and though they were good value in one sense of the word they did not appeal to many purchasers from the standpoint of a house in which one could really settle down.

In the latter case the faults commented on were inferior construction, similarity of design and lack of architectural treatment, or the failure to give sufficient study to the interior layout and design which from every good housewife's standpoint is possibly the most important consideration of all.

Shoddy Houses Found Readier Sale

Many builders and contractors met this need in 1921 by erecting small dwellings of pleasing appearance, and by building sufficient numbers were able to place their houses on the market at an attractive figure. Unfortunately real estate values declined in the fall when these builders found some of their houses on their hands and only the cheaper speculative built structures found a moderately active market. As an example of this condition it can be cited that in one section of the city several well built houses at prices allowing of only 7% profit which included all overhead expenses remained idle while imperfectly built houses found a ready sale at $5,500. with a return to the builder of nearly 20%, the purchasers being attracted solely by the low prices and unaware of the exact nature of the construction until after it was too late when plaster began to fall off, finish to open up, windows and doors to fit improperly and last but not least to find the heating system to be totally inadequate.

It is only reasonable to suppose that many of our reliable builders and contractors resent this practice and consider it as a reproach to their calling that so many poorly built houses have been and are still foisted on an unsuspecting public although it must be borne in mind that this same public is somewhat to blame for they are not always willing to pay the price for the best of materials and high grade workmanship..

The houses described and illustrated in this article were erected with a view to overcoming these difficulties. A comprehensive scheme was developed whereby rows of six houses, two detached and four semi-detached would be built en bloc. The first three have just been completed and from the illustrations it will be seen that the architectural treatment of each front elevation is distinctive, while on rereferring to the plan, the interior design will be found to be the same for each house.

The district selected for the commencement of this scheme was a new subdivision in the Woodbine-Danforth district, the three houses referred to have been erected on Glebeholme Blvd. just west of Woodbine Ave. This district had many advantages for the location of the moderately priced houses, for land values were reasonable, varying upward from $35.00 per foot, and local improvements such as electric light, gas, sidewalks, etc., were available. Certain sections of the district were nicely wooded and the whole of convenient access to the Danforth Ave. car line, giving a frequent service to the heart of the city. Danforth Ave. itself is noted for its up-to-date stores of every description where dealers claim goods can be purchased cheaper than in any other part of the city.

The question of the location of schools and churches was also carefully studied before a selection of the site was made and as a result the district referred to has practically within its borders both public and separate schools. A Catholic church is built, while an Anglican church is now in course of erection.

Square House Preferred

With regard to the actual apportioning of land to each house, several features are worthy of note. The square planned house was decided upon primarily from a consideration of the most economical conservation of hall and stairway space but also to secure the most natural light possible in all parts of the house. The shortening up of the structure has the added advantage of leaving as large a garden space as possible. Lots not less than 120 ft. deep were selected, these giving adequate accommodation for garage space, for in connection with the scheme it was planned to provide mutual side drives 7 ft. wide carrying back from the street line for not less than 73 ft. 6 in., this length having been found to be the minimum distance in which an automobile could be conveniently manoeuvered. The adoption of the "square plan" design added 5 feet of land at a cost of $175.00 but nearly 50% of this cost was saved in providing additional useful accommodation and in the elimination of dark and unnecessary hall space.

As has already been noted the interior design of each house is the same and comprises six rooms and bath, also full basement. The superficial area of the main and first floor is 1,021 square feet of which 150 square feet only is taken up by halls and stairway, the latter being 14.7% of the former which is considerably less than usually obtains in homes of this type. This feature was arrived at by carrying the main stairway through into the kitchen securing it by wrought iron hangers from the joists and trimmers.

The first floor, although carried on 2 by 8 joists at 16 inch centres, is supported by a solid 10 by 10 inch beam on 10 by 10 inch posts, all of B. C. fir, giving a stability of 30% in excess of the building by-law requirements.

A feature worthy of note on the first floor is the large living room 11 feet 6 inches by 14 feet 2 inches with tapestry brick fire place, complete with mantel, ash chute etc. The kitchen and pantry accommodation was given particular consideration and has an area of 77 square feet. Very spacious cupboards are provided on the rear wall and extending over the sink, all, as will be noted, of easy access from the dining room. Incidental features are a large drip board, baking board and built-in ironing board.

The second floor has three rooms ranging from 87 square feet to 129 square feet, each with spacious clothes closets. The linen closet is roomy with four shelves, and does not cramp the hall space. The bathroom has 49 square feet of floor space and is finished off with a dado on Keen's cement with tiled design. From the den or third bedroom there is a manhole to the attic, the latter being finished with rough flooring for the storage of trunks etc.

Exterior Treatment

The exterior treatment was unique in many ways. Black wrought iron was used to give artistic relief in the down pipe fasteners, grillage over the side-drive and in the fastenings for the verandah roof. Casement sash were used throughout except in the kitchens where box sash were employed but in the detached house steel casement sash were used exclusively.

All materials used were the best of their respective kinds, footings being of concrete 1-4 gravel mix, foundation walls, 14 inches thick of Don Valley common brick, front elevation of oriental tapestry brick of varying colours, while the side and rear wall were of Don Valley grey stock, to accentuate interior lighting conditions.

Framing lumber throughout was B. C. fir and cedar and the trim was of selected chestnut for the first floor and Georgia pine for the second floor. The latter was finished off in white enamel with birch doors in mahogany for relief in colour.

Wherever stucco was used for ornamental effect the same was executed in three coat cement mortar work on metal lath.

The floors throughout including the kitchen were of select oak match laid or a 1 inch rough diagonal flooring.

The electric wiring was adequate, care being taken in the placing of all outlets having due regard to the probable placing of furniture. Every outlet had individual switch control and vacuum plugs were provided on each floor also a special plug in the kitchen for iron, etc.

The plumbing specifications called for metal rimmed tubs in cellar, large sink in kitchen with rolled back, and for the bathroom a 5 foot 6 inch bath, rolled rim wash basin, and an enamelled tank water closet. All piping was of full size, particular attention being paid to the gas line which was of 1 inch diameter.

The heating system is hot air supplied from a Hecla furnace made by the Clare Bros. Co., Ltd., Preston, which has a capacity of 15,000 cubic feet. A fact worthy of note is that the capacity of this furnace is 66.7% in excess of the cubic content of this house.

Cost Data

The cost of these houses per cubic foot with labor nearly at the peak is as follows:—Detached houses, 38 cents; semi-detached, 34 cents.

Percentage costs by trades etc. are as follows:—

	Detached;	Semi-detached.
Land	13.24%	13.40%
Surveys	.07	.08
Lawyers' fees	.16	.17
Taxes	.12	.13
Permits	.08	.09
Plans	.25	.15
Water connection	.48	.48
General overhead	2.48	2.92
Equipment	.55	.61
Supervision	1.02	1.67
Laying out	.06	.11
Excavation	.57	.77
Concrete footings	.82	.98
Concrete floors	.32	.35
Concrete sidewalks	.28	.44
Cinder driveway	.10	.11
Drains	1.33	1.47
Brickwork	12.89	15.49
Carpentry:—		
Framework	16.22	16.49
Doors & trim	1.31	1.49
Windows & trim	5.36	3.82
Floors	1.56	2.46
Shingling	.66	.82
Miscellaneous, trim, etc.	14.18	10.40
Plumbing	5.41	6.83
Wiring	.87	.96
Heating	2.57	2.87
Plastering — inside	2.64	2.87
Plastering — outside	1.14	
Lathing — inside	1.21	1.59
Lathing — outside	1.28	.04
Tinsmithing	1.25	1.39
Painting	4.54	4.47
Glazing	.71	.63
Tar & gravel roof	.29	.32
Hardware	1.99	2.47
Fences	.96	.89
Grading	.18	.62
Cleaning up	.15	.17
Sodding	.09	.11
Insurance	.46	.49
	100%	100%

The entire scheme was planned, and the design of the dwellings and construction carried out by

Messrs. Weddell & Saunders, engineers and contractors, Toronto.

The following firms were associated in connection with various sub-contracts:—Plumbing & heating, Messrs, A. Welch & Son; wiring, Messrs. Bates & McPherson; plastering and stucco work, H. Williamson; steel sash, Henry Hope & Sons.

It should be noted with regard to the latter that this was the first occasion upon which standard steel casement sash were employed in the construction of moderately priced dwellings.

Mainly Constructional

East and West—From Coast to Coast

Demolition of the old parliament buildings in Winnipeg, for 38 years the seat of the government of Manitoba, will commence April 15.

The Plumbers' Union at Winnipeg has accepted a 10 per cent. cut in wages, the new scale of 90 cents an hour going into effect on May 1.

The numerous brick plants near Milton, Ont., are said to be engaging large numbers of new hands and have adopted a 10-hour day in anticipation of a busy season in construction work.

Contractors in the carpentry, painting and bricklaying branches of the building industry, at Vancouver, have signified their intention of cutting wages 50 cents per day in the first two trades and $1.00 per day in bricklayers' wages.

Master painters at Calgary have reduced the wages of labor in this trade from 80 cents an hour to 70 cents, with a nine-hour day during the summer moths. No difficulty is anticipated in having the men agree to this new arrangement.

At a recent conference of the Board of Control of Toronto and members of the Department of Highways, it was made known that the city's share in the cost of constructing the entrances of various highways to the city this year will amount to about $300,000.

Ford City, Ont., has made application for a further loan for housing purposes, but without success. This municipality has nearly reached the end of its finances, $203,000 of the $250,000 allotment having already been spent on home building. Applications for houses already on hand will utilize the remaining $47,000 this year.

The Housing Commission at Oshawa is planning for a busy season this year. The city council has authorized the construction of ten houses, in addition to ten which were authorized earlier in the year. The commission has to date built over 100 homes and has spent over $500,000 of the original $600,000 allotment.

The Quebec Running Streams Commission, it is reported, will build a large dam on the Ouarea River in the Laurentian Mountains, beyond St. Agathe, at a cost of $250,000. The work is to be started this spring and will include the erection of storage dams at Lakes Ouarea, Archambault and Blanc for the better utilization of waterpowers.

The Private Bills Committee of the Legislative Council, at Quebec, limited the amount to be borrowed by Montreal for the construction of a new city hall, to replace the old building burnt recently, to $1,500,000. Mayor Martin endeavored to secure a much larger amount for this building, but without avail. The new city hall will be erected on the site of the old building.

A large housing development involving the erection of some 60 houses on the Gage Estate, at the corner of Bathurst St. and Davenport Road, Toronto, has been announced by Mr. A. E. LePage, well known local realtor. The houses will be of the English cottage and colonial designs, and will cost from $15,000 upward, the entire scheme involving the expenditure of over $1,000,000. The company behind the development will be composed of local financiers.

The annual meeting of the Saskatchewan Land Surveyors was held recently at Regina, at which the following officers for the coming year were elected: president, M. B. Weekes, director of surveys for Saskatchewan; vice-president, E. H. Weekes, Saskatoon; secretary-treasurer, H. G. Phillips, Regina. Councillors: H. K. Moberly, Yorkton; D. T. Townsend, Calgary; Lt.-Col. A. C. Garner, Regina, and W. A. Begg, Regina. The first honorary member of the association was created in the person of Mr. C. J. Milligan, of Regina, who has been associated with this organization for the past ten years.

Personal

Mr. C. E. Fraser has been appointed township engineer and road superintendent of Birch Cliff, Toronto. Mr. Fraser was formerly connected with the engineering organization of James, Proctor & Redfern of Toronto.

Mr. E. Gillis has been appointed superintendent of the water works department at North Sydney, N. S., and will take over the responsibilities of this office from town engineer McDonough, who has hitherto had charge of this department in conjunction with his other duties.

Hon. Sir Lomer Gouin, Minister of Justice of Quebec, recently officiated at the laying of the corner stone of the new Mount Royal Hotel at Montreal. This building will be the largest hotel structure in the British Empire, when completed, and will cost about $9,000,000. The stone was laid at the southwest corner of the building, on Peel St.

Mr. Harold McEvers, architect of Windsor, Ont., was successful in having his plan for a new executive and office building for the Walkerville Hydro-electric Commission, selected by the commission from a total of ten submitted. Mr. McEvers will proceed with the preparation of working plans. The estimated cost of the building is $60,000.

Obituary

Mr. Jos. Hall, former head of the Windsor Water Works Department, died recently in that city at the age of 83 years. Deceased was born in England in 1839 and came to Canada at an early age. He lived in Toronto for a number of years, from where he moved to Windsor, being appointed chief engineer and superintendent of the local water works system in 1875.

Mr. Wm. Daly, prominent contractor of Stratford, Ont., died recently in that city, at the age of 73 years. Deceased was born in the township of West Nissouri and for the past 40 years had lived in the city of Stratford. Many of the city's largest buildings were constructed by him, among which are included the public library, fire hall, market shelter, Whyte Packing Company's plant, besides many smaller buildings and residences.

Mr. Gordon M. McGregor, chairman of the Essex Border Utilities Commission, and one of Windsor's most prominent business men, died recently in Royal Victoria Hospital at Montreal, following an operation. Deceased was born in Windsor in 1873 and was educated in that city and in Winnipeg. He was connected with several of Windsor's large industries, being general manager of the Ford Motor Company of Canada, director of the Ideal Fence & Spring Co., and of the Windsor Petroleum and Refining Co. besides several others.

CONSTRUCTIONAL ACTIVITY

Period of March 15 to March 24, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Aylmer, Ont.

Malahide Twp. Council plan drainage work to cost $8,500 on Bradley Creek Drain. J. M. Hale, clerk, Aylmer, Ont.

Bartonville, Ont.

Tenders will be called for construction of sewer for Town and Wentworth County Councils. E. R. Gray, Engr., City Hall, Hamilton.

Calgary, Alta.

City will grade 17th Ave. and 19th St. W. at cost of $12,000. G. V. Craig, City Engr.

Caughnawaga Reserve, Que.

B. Michaud, Deputy Min. Dept. of Roads, Prov. Govt., Quebec, will receive tenders until April 5th for construction of about 4½ miles of waterbound macadam with bituminous application.

Chilliwack, B.C.

Plans are being prepared for waterworks extension to cost $40,000 for Elk Creek Waterworks Co., Chilliwack.

Dunnville, Ont.

E. H. Darling, Engr., 47 Home Bank Bldg., Hamilton, has plans and will receive tenders until March 31st for construction of filtration plant to cost $45,000 for Town. Plans also with W. E. Swartz, secy.-treas., Dunnville.

Gentilly, Que.

Construction of macadam road is planned by Town Council. L. Bubois, secy.-treas.

Halifax, N.S.

W. A. Hendry, Chief Engr., Dept. Pub. Highways, Prov. Govt., will receive tenders until March 27th for two sections of gravel roads and until March 30th for 1 section of gravel road. Plans with Highways Bd., Halifax. Accepted cheque for 10% of tender required.

Kincardine, Ont.

Plans will be prepared for filtration plant for Town.

Lachine, Que.

Town Council plan construction of pavements at cost of $105,000 on Notre Dame St., 6th, 10th and 18th Aves.

Levis, Que.

B. Michaud, Deputy Min. Dept. of Roads, Prov. Govt., will receive tenders until April 3rd for construction of either gravelling or of waterbound macadam on Levis St., Lambert Highway in parishes of Contrecoeur (10.2 miles), Verchères (3.6 miles), varennes (3.4 miles), and for gravelling in parishes of St. Pierre de Sorel (1.8 miles), St. Victoire (2.7 miles), St. Ours (3.2 miles and St. Roch (2.4 miles).

London, Ont.

Middlesex County Council plan construction of 6 concrete culverts on Pipe Line Rd. near London and 1 at Strathroy. Chas. Talbot, Engr., County Bldgs., London.

Mitchell, Ont.

Jno. Roger, O.L.S., Mitchell, Ont., Clerk Hullet Twp. Council, will receive tenders until March 31st for construction of drain. Marked cheque for 5% of tender required.

Montmorency, Que.

General contract for roadwork costing $31,000 in Villages of Montmorency, Gifford, Beauport and Charlesbourg, Que., for Quebec County Council, is awarded to Emile Cote, Montmorency, Que.

Montreal, Que.

Tenders will be received until April 3rd by B. Michaud, Deputy Min. Dept. Roads, Prov. Govt., for gravelling Montreal-Mont Laurier Highway in Parishes of St. Sauveur (6.9 miles), St. Joseph de Mont Rollard (2.6 miles) and Ste Adele (7 miles).

B. Michaud, Deputy Min. Dept. Pub. Roads, Prov. Govt., will receive tenders until April 3rd for construction of either gravelling or of concrete pavement on Montreal-Sherbrooke Highway in St. Cesaire Village (1.1 miles) and for gravelling in Orford Twp. (2.6 miles), Rock Forest (4.4 miles), Petit Lac Magog Village (1.1 miles), Eastman Village (4.2 miles), Waterloo Town (0.9 miles), Shefford Twp. (7.5 miles), St. Cesaire Parish (1 mile) and Magog Twp. (3.5 miles).

Ottawa, Ont.

Plans are being prepared for construction of one mile pavement on Richmond Rd. for Suburban Roads Cmsn., Thistle Bldg. Alan K. Hay, Engr.

City Council will construct pavement on Wilbrod St. A. F. Macallum, Commr. of Works.

A. F. Macallum, Commr. of Works, has specifications and will receive tenders until March 30th for water meters to cost $30,000 for City.

St. Catharines, Ont.

F. N. Rutherford, 24 Queen St., St. Catharines, Lincoln County Engr., will receive tenders until April 1st for 14 miles waterbound macadam in lengths of 1 to 4 miles, 5 miles of bituminous macadam in lengths from 0.5 to 2.0 miles, supply and application of bituminous surfacing tar and asphalt for various road purposes, for Lincoln County Council. Marked cheque for $500 required.

Seaforth, Ont.

Jno. A. Wilson, clerk, has plans and will reecive tenders until April 8th for construction of waterworks extension for Town. Plans also with James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Simcoe, Ont.

Town Council plan construction of concrete pavement on Argyle, Queen, Cedar and Robinson Sts.

CONTRACTS AWARDED

Eastview, Ont.

General contract for construction of sewers at cost of $65,000 for Town Council is awarded to Thos. McLaughlin, Somerset St., Ottawa.

Railroads, Bridges and Wharves

Chambly Bassin, Que.

Erection of concrete and steel bridge is contemplated. I. E. Vallee, Engr., Dept. Pub. Works, Prov. Govt., Quebec.

Halifax, N.S.

Geo. E. Vanbuskirk Co., Ltd., Almon St., have plans and will receive tenders, no closing date set, for construction of trestle for railway cars.

Ste Marie de Monnoir, Que.

H. St. Maire, secy.-treas., has plan and will receive tenders until April 3rd for construction of bridge for Municipal Council. Accepted cheque for 10% of tender required.

St. Ignace Coteau du Lac, Que.

A. Dumesnil, secy. Town Council, Coteau du Lac, has plans and will receive tenders until March 29th for construction of concrete bridge. I. E. Vallee, Engr., Dept. Pub. Works, Prov. Govt., Que.

St. Samuel, Que.

Construction of 2 concrete bridges is contemplated by Town Council. Aug. Boisclair, secy.-treas.

Saskatoon, Sask.

Construction of bridge is contemplated by City Council. G. D. Archibald, City Engr.

Thetford Mines, Que.

Plans are being prepared for steel bridge for City. I. E. Vallee, Engr., Dept. Pub. Works, Prov. Govt., Quebec.

CONTRACTS AWARDED

St. Mathieu de LaPrairie, Que.

J. A. Dore, Chateauguay Village, Que., is awarded general contract for construction of concrete bridge for Town Council.

Public Buildings, Churches and Schools

Belleville, Ont.

Tenders addressed to W. J. Diamond, secy.-treas. of School Bd., will be received until March 25th for erection of school to cost $130,000. Plans with MacLean Building Reports Ltd., 345 Adelaide St. W., Toronto, and Beaumont Jarvis, architect, 8 Campbell St., Belleville. Marked cheque or bond for 10% of tender required.

Campbellville, Ont.

Trustees S. S. No. 8, Nassagaweya Twp., Ont., contemplate erection of school at cost of $15,000. John Marshall, secy., Campbellville.

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Cutting off the Nose to Spite the Face

The labor element in some of our cities has gone crazy.

In Guelph, for example, a resolution was recently passed by the Trades and Labor Council asking the Ontario Government to enact legislation preventing any one from charging more than 5 per cent. interest.

In Toronto the Unemployment Council of the Trades and Labor Council held a meeting of the unemployed in Massey Hall at which they advocated the cessation of interest payments on Victory Bond holdings exceeding $500.00.

Any thinking man can see how disastrously such action would react on labor itself. Their very existence depends on the freedom with which money is invested industrially. The effect of a maximum rate of 5 per cent. would immediately drive all surplus funds out of the country. Factories and public works would have to close down simply because there would be no money to carry on. Deferring Victory Bond dividend payments would have the same effect. It would seriously impair the confidence of the investing public and foreign money would stay away entirely.

It is a pity labor leaders are so short sighted as to start their followers thinking along such stupid lines. Perhaps it is all inspired by a desire to injure "Capital," but if so, it's very weak reasoning. Of course it would injure capital to a degree — but it reminds one forcibly of the Sinn Feiner who, a few days ago, in an endeavor to cause destruction with a bomb was himself blown to pieces as it left his hand.

It is a trite saying that high interest rates and prosperity go hand in hand. A low interest return presupposes lack of demand for money. It is only when industry is active and profitable that those engaged in it are willing and able to pay high rates for extensions and developments. Wherever interest returns are highest, other things being equal, the activity is greatest. Six months ago, for example, the turnover, on the Stock Exchange in any particular Victory Bond was from a half to three quarters of a million. To-day, with rates around 5 per cent., the turnover is a few thousands. Money is looking elsewhere for a higher return. If the construction field is attractive, much of it will go there and the unemployed will reap the benefit. The same is true of manufacturing industries.

By advocating a fixed low rate for money, the unemployed are heading straight for a perpetuation of their present condition.

Quebec Province to Give Greater Attention to Road Maintenance

Road maintenance is to receive a more important place in the highway policy of the province of Quebec, according to a bill which the provincial government is fostering. The act which makes several more or less important amendments to present legislation, is chiefly concerned with conserving the large investment that Quebec has made in roads, by assuring their adequate mointenance and repair. For this purpose, it provides for the establishment of a branch of the Department of Roads under the name of the Maintenance and Repairs of Roads Bureau, directed by an official called a general superintendent of maintenance and repair of roads.

The subsides authorized by the act and the expenses which the minister of roads incurs in carrying out the act are to be paid out of the sums voted each year by the legislature for the improvement and maintenance of roads and out of a sum of one million dollars which the provincial treasurer is authorized to take from the monies deposited in the consolidated revenue fund.

Out of the sums voted annually by the legislature for the improvement and maintenance of roads the minister may grant to any municipality a subsidy equal to a half of the expenses it has incurred for the improvement of a road.

If a municipality prefers, it may petition the government to carry out repair work, which work will come under the jurisdiction of the newly created department, the government remitting to the municipality at least fifty per cent. of the cost incurred in maintenance.

The bill classifies the roads for the purpose of maintenance, as provincial highways, regional roads, improved roads, and earth roads. Fifty per cent. of the cost of maintenance of provincial and regional roads is borne by the province, and the other fifty per cent. by the municipalities. The new measure provides that the municipalities cannot be made to pay more than fifty per cent. but that the government may increase its own contribution, thereby lowering that of the municipalities. This would be according to circumstances, special conditions in various counties determining the proportion paid by the government at the discretion of the minister of roads.

Improved roads are now maintained and repaired in some cases by the municipalities themselves, in other cases by the Department, which charges the cost to the municipalities. Under the new act, the municipality may keep the maintenance in its own hands and receive no grant. If it neglects to keep the roads in good order, the minister of roads, on the report of the superintendent of maintenance, may do the work and charge the cost. Or the municipality may have the roads repaired and maintained by the roads department if it thinks it well to do so. The new measure provides that when the municipality decides to have the government do the work, the minister will determine the proportion of the cost which the municipality should pay, taking into account such facts as local and outside traffic, but once the municipality makes a contract of this kind with the department it may not break it without the consent of the department. There are in the province 30,000 miles of earth roads and to aid in keeping them fit the new act permits the minister of roads to make grants for the construction, maintenance, and repairs of earth roads, and bridges connected therewith. At present there is provision whereby the government grants $400 per municipality for earth roads and the new measure provides that the minister may increase or lower this amount according to the circumstances as he sees them.

In the matter of what are called secondary roads, built generally of gravel, the old law permitted the minister of roads to grant up to $500 for gravel roads and $1,000 for macadam roads per mile. As the government believes that this will be the kind of construction most used in the future, and that municipalities should be encouraged to build such roads, it has been decided to strike the limitation of $500 and $1,000 and permit the minister to make a grant equal to fifty per cent. of the cost of construction. The law also puts village municipalities on the same footing as parish municipalities. Hitherto grants for villages applied only to the main street, and were limited to forty per cent. of the amount of the grant.

Getting Public Confidence

"I feel that a remedy for this (lack of public confidence in prices), which might be carried through most organizations, is to give to the consumer, the man at the lower round of the ladder, the man whose money we are after and must get to conduct our business—to give him more information than he has had with reference to our problems."—E. W. McCullough at the conference of the Associated General Contractors of America.

Public Works Expenditures

According to a report of the Dominion Department of Public Works covering the fiscal year ended October 31, 1921, out of nearly $8,250,000 disbursed throughout the Dominion for public works, chiefly in harbor improvements, a total of $1,600,000 was spent on Toronto's harbor.

Distribution by Provinces

By provinces the expenditures on public buildings during the year ended October 31 last were as follows: Nova Scotia, $190,266.96; Prince Edward Island, $29,886.84; New Brunswick, $158,725.53; Quebec, $703,109.38; Ottawa, Government Buildings, $5,117,100.74; Ontario (excluding Ottawa), $1,167,562.20; Manitoba, $269,686.34; Saskatchewan, $145,260.07; Alberta, $184,964.11; British Columbia, $326,927.48; Yukon, $39,432.35.

Distribution in Ontario

Expenditures on harbor and pier work in other towns and cities of Ontario were as follows: Bare Point, breakwater, Port Arthur, $298,714.56; Bowmanville, $15,044.26; Bronte, pier, $2,011.15; Cobourg, piers, $9,957 21; Fort William, harbor improvement, $171,669.50; Huntsville wharf, $3,076.65; Jeannette's Creek, $37,036.78; Kincardine pier, $4,138.43; Kingston harbor improvement and other work, $12,646.88; Kingsville piers, $22,946.40; Leamington pier, $9,192.42; Little Current, rebuilding wharf, $23,989.98; Meaford, revetment wall, $504.68; Oakville, $11,027.12; Owen Sound, $11,717.05; Pelee Island, piers, $8,558.44; Point Edward, $2,457.60; Port Burwell, pier, $46,346.86; Port Colborne, breakwaters, $13,142.86; Port Dover, piers, $19,786.83; Port Hope, piers, $6,673.43; Port Stanley, harbor improvements, $46,745.75; Rondeau Harbor, $15,883.36; Whitby, $4,689.40; Windsor, $2,694.63.

The total cost of the operation of the central heating plant for the Government buildings in Ottawa for the year ended October 31 last was $273,538.36.

Public Opinion an Asset

Col. Shelby said at the A. G. C. conference that: "Public opinion is one of the largest assets in any industry. To direct and properly influence public opinion is particularly the function of organized effort in such industry. It is not half as important that individual contractors should make large individual profits, as it is that the great construction industry should be right."

Fuel Saving Possibilities in House Heating

The Dominion Government has just issued report No. 10, entitled "Fuel Saving Possibilities in House Heating." The report has been prepared by L. M. Arkley, Professor of Mechanical Engineering, Queen's University, and by James Govan, architect for the Department of the Provincial Secretary, Ontario. This report was written for the purpose of bringing to the attention of householders and builders data and information that would enable them to build more scientifically and at the same time economize on fuel consumption. It is divided into two parts, the first by Prof. Arkley, entitled "Fuel Saving in Furnace Installation and Operation," and Part II by Mr. Govan on "The Advantages of Better Insulation; Planning for Sunlight and Improved Air Conditions." This is a valuable report, which we recommend every builder to study.

Water Resources Paper No. 30 has just been issued by the Dominion Water Power Branch, Department of Interior, Ottawa. It is a report of the hydrometric survey covering the Pacific drainage in British Columbia and the Yukon territory, for the climatic year 1919-20. R. C. Swan, district chief engineer, is the compiler of the report.

Restoration of the Water Supply of New Westminster, B. C.

City Forces and Private Contractor Have Been Engaged in Repairing the Pipe Line Destroyed in the Floods of Last October—An Interesting Piece of Work Carried out in Winter Weather

Four weeks of strenuous effort by a special force of men organized by the Nickson Construction Company, of Vancouver, B. C., completed the efforts put forth by the engineering and water service departments of the city of New Westminster, B. C., in the past four months to restore the normal water supply to the city. With the announcement, appearing in the daily press on Saturday, March 4th, that the mains were once more delivering water to the city system from Coquitlam Lake, the end came to a long and strenuous campaign carried on under winter conditions of unusual severity.

Edge of chasm cut by Coquitlam river flood, showing 25-in and 14-in. pipe lines left in the bank

At the first of February, the Nickson Construction Company, commissioned by the New Westminster council, took the first steps to organize a crew of men to work in the Coquitlam valley on the restoration of the supply main which had been so badly damaged by the floods of last October. A camp was established six miles up the valley from Coquitlam Junction, supplies being taken in over a portion of the distance on the Dollar Company's logging railway. In the four weeks following, roads were put in moderately passable condition, large amounts of supplies and material, plant and equipment were assembled, pipe for a temporary pipe line transported and laid, closing the two long breaks in the line and the main object of the "drive" accomplished, that is, water is being delivered in sufficient volume to fill the system in the city and provide ample supply for the first time since the main went out of commission.

Extent of the preparations

Some idea of the extent of the preparations necessary for coupling up the pipe line may be gathered from the fact that twenty teams of horses were required at one time to transport the plant and equipment. Three donkey engines were dismantled, the boilers, engines, drums, etc., being hauled in by wagon six miles, and the donkeys reassembled on the work. Fifty thousand feet of lumber, much of it large dimension timbers, had to be taken in to the location. The erection of a camp to accommodate over one hundred men and the organizing of the crews and the providing of supplies was a considerable task in itself.

Temporary Line to Silver Creek

When the pipe line went out of commission after the floods which culminated on October 28th last, the city engineer of New Westminster, H. Stewardson, at once organized a crew of forty or fifty men and began the work of repairs. The first effort was directed to securing a temporary water service to meet at least part of the requirements of the city, whose supply had been totally interrupted. The engineer decided on tapping Silver Creek, a small tributary coming into the Coquitlam River from the west. To do this a small dam was constructed on the creek and 1,400 feet of 14-inch pipe laid to connect with the 25-inch main at a point below the last break. The pine for this purpose was a portion of the original 14-inch supply main laid nearly thirty years ago, and which had remained in commission after the 25-inch main was completed in 1912. The 14-inch main was also broken by the floods, and it was thought best to dig up sufficient of this pipe to make the temporary main from Silver Creek.

This work was successfully completed in a very short time and the city began to enjoy the prospect of at least a limited regular supply, when heavy frosts slowed down circulation in all the mountain streams and Silver Creek became a mere trickle. From that time every effort was made to repair the breaks in the 25-inch main. The winter weather conditions made this repair work a strenuous task, but the city's crew of forty men, under water superintendent J. Ankers, went at it with vigor and relaid the two

Temporary wood stave pipe line replacing mains torn out by flood which eroded the river bank seen in the picture lower breaks, each about 1,600 feet in length. Some of the incidents of the task are most unusual. For instance, at one of the breaks the length of pipe which had to be relaid was doubled because the workmen found that 800 feet of pipe had been filled solid with gravel, packed in by the force of the floodwaters as solidly as if it had been rammed in. It was necessary to pick this out, a slow and laborious task, involving also the taking up of the pipe for that distance.

The work of straightening out battered sections of pipe, of which there were many, was done with jacks, sledges and hammers, aided by big gasoline torches, with which the pipe was heated to a point that made hammering easier. As it is 3/16 in. thick, cold hammering in frosty weather would have been much slower. At the same time as the city engineer's men were repairing these breaks, heavy concrete supports were also made at 15 foot intervals, and the pipe laid in these. Later there will be rock protection work and a roadway between the river and the line of the pipe. This will be filled to a minimum depth of one foot over the top of the pipe line, and the rock breakwater is to be heavy enough to hold the stream in its channel even at extreme high water.

Temporary Wood Pipe Main Built

Faced with the possibility of high water coming again with spring weather before the 25-inch main was completely restored, the city supplemented the efforts of its own engineering and water departments by entering into a contract with the Nickson Con- in a temporary 14-inch pipe line across the two upper struction Company to undertake the work of putting in a temporary ¼ inch pipe line across the two upper breaks and to go ahead with the restoration of the big main in those locations and to construct the rock breakwater and fills to protect the line against future floods. In the two breaks still to be repaired at that time there were 1,200 and 500 feet of main to be replaced. In the breakwater and fills there was a total of 78,000 cubic yards of materials to be handled. To do this heavy plant was necessary and it was a matter of economy for the city to secure a contractor who had such equipment rather than to purchase it.

Fourteen inch wire wound pipe built for 250 feet head pressure was delivered by the Pacific Coast Pipe Company of Vancouver over the logging railway to the work, as soon as the Nickson Company started operations. In fact, the erection of camp, hauling in lumber and supplies, repairing roads, assembling plant, and making ready to lay the temporary pipe line were all going on at once. The decision to use the wood pipe was because it was found that it was not economical to continue digging up the old fourteen inch main in frozen ground. The city will use the wood pipes elsewhere after the 25-inch supply main is restored.

The temporary pipe line was laid on the surface of the ground where conditions permitted, and at places where crossings were necessary over the river, rough timber trestles were built, to which the pipe was securely fastened by half inch round iron bands. These trestles were also necessary in places where the river had cut away the side hill leaving only sheer banks. Where curves were necessary the pipe was anchored by timbers braced against trees and rocks, with light wire cable also taking the strain. At some points many heavy logs were rolled into place alongside and over the pipe to hold it steady. In this way every precaution was taken that this temporary pipe line would give efficient service, barring accident from further freshets, until the permanent main is restored. Heavy steel rivetted reducers connected the 14-inch pipe with the 25-inch steel pipe, the joints on the latter being leaded. When the water was turned in on March 4th, not a leak developed in either the temporary or restored portions of the line.

Permanent Repairs

Work now proceeding is taking the form of building up a permanent grade for the 25-inch steel main, and protecting it with the heavy rock wall laid on the stream side, with the roadway between the wall and the main. The breakwater averages 6 feet in height, with a 2 to 1 slope on the outside and 1 to 1 slope on the inside and with a 6 foot top. The fill will be a foot higher than the top of the pipe and the roadway will be ten feet wide. In one place where the swirling waters tore out a great excavation, the rock wall is twelve feet high. Boulders from the bed of the river, now at extreme low water, are swung into place in the wall by means of derricks, three donkey engines being used for power. The timbers for the derricks had to be brought in and the derricks built on the ground. As the wall proceeds the derrick is moved forward on top of it. Behind the wall a crew of men is busy making concrete piers to support the pipe line. The forms are set up 15 feet apart and each pier is 18 inches thick.

Some changes in grade in the main are resulting from the work of restoration, though the line as a whole is well under the hydraulic grade line. In one place the grade is being dropped sixteen feet to reduce the amount of fill necessary across the one chasm caused by the washouts. At all points the replaced pipe is to be anchored to the concrete piers on which it rests. Bolts are imbedded in the concrete and bands will be fastened over the pipe to these. Much of the 25-inch pipe washed away will be salvaged. Some of it has already been used in repairing the two lower breaks. Sections in which sharp folds were caused when the pipe was dashed down by the floods cannot be restored economically, as cracks and leaks develop in straightening them out. In all it will require 2,000 feet of new pipe, or about half the amount washed out.

It is anticipated that the big main will be completely restored before high water begins, which is usually towards the end of April in each year. As there is not the usual amount of snow in the mountains this year, no heavy floods are anticipated. The length of this main from the dam at Coquitlam Lake to New Westminster is 16 miles. In 1910, when the B. C. Electric Company undertook to erect the huge dam which raised the level of Coquitlam lake 60 feet over an area of ten square miles, the city of New Westminster began to lay its 25-inch supply main to anticipate future needs. That main is ample for the demands on the city water service, as well as supplying the city of Coquitlam and the rural district of Richmond, both of which communities have received their supply from this main. It is not the present intention to restore the 14-inch main.

New Roadway Will be Built

Along with the work of restoring the pipe line and putting in protection works as outlined, there is going ahead the project of rebuilding the highway from Coquitlam junction, where it leaves the main public road, up to Coquitlam Dam, a distance of between seven and eight miles. This roadway is highly important to the B. C. Electric Company which shares the dam with New Westminster. This dam impounds in Coquitlam lake, high up in the mountains, a huge volume of water which is carried by tunnel under the mountain into Lake Buntzen, on the watershed of Burrard Inlet, where the electric company's hydro-electric power house is located. The proposed roadway will be a heavy grade to replace the light temporary road opened during construction days on the dam.

The cost of this grade, it is proposed, will be shared by the city of New Westminster and the B. C. Electric Company, with the provincial government possibly contributing as it will be a highway when completed, opening up some valuable areas close to centres of population. The Nickson Construction Company, which has the work in hand for the city of New Westminster is to go on with the road in conjunction with its work on the pipe line. Having plant and equipment assembled on the ground and a large crew of men organized, the work can be done better now than at any time later. Having taken over the construction crew which the city had on the water main repairs, some forty men, the Nickson Company is prosecuting its undertaking with a force of about 150 men. Mr. E. H. Longley is resident engineer, representing the city and Mr. Wm. Hayman is city inspector in charge of time and materials.

The camp erected early in February at Coquitlam is mainly of tents, large marquees being erected on wooden floors, with walls some three feet up. Large stoves in each tent keep them warm and comfortable for the men when they come in from working in the snow and ice water of the river. A large frame building for dining room and kitchen, roofed with heavy tarred felt paper has taken good care of that important feature of the construction camp. The distance from New Westminster is less than 15 miles, and the unemployed of that city have been drawn upon for the gangs to carry out this important and interesting contract. Equipped with heavy rubber hip boots the men apparently find no serious difficulty in their work. Despite rough conditions and the temporary camp hastily erected in winter, the number of men who have fallen ill with 'flu or colds has been very small in this camp, possibly less even than in the cities where the epidemic has been very prevalent.

Roots a Menace to Sewers and Drains

The Interference of Underground Tree Growth with Sewers is a Serious Problem—Concrete Eaten Away by Roots in the Endeavor to Reach the Warm Moisture

By W. G. CAMERON

Assistant Engineer, Sewer Section, Works Department, City of Toronto

In most of our large centres, where we have sewers and shade trees, these latter are planted without any consideration of the fact that certain varieties cause great damage to private drains and main sewers and therefore put the community to much needless expense. Most of us who have had experience with drains and sewers have found, in many cases, private drains and main sewers blocked, and on investigation have discovered the cause to be the roots of trees. These roots do not discriminate, but make for the place where they can get most moisture, and where this moisture is warm, as it is in sewers, they grow very rapidly and all the year round. Many measures have been recommended and tried as a cure for this trouble, but so far I have failed to find a universally successful antidote. Roots always seem to find a hole or be able to dissolve certain materials in their way. Even where neat cement of medium thickness is used, such as in joints in the pipe, roots find their way through and after the entrance is made, branch out and increase in size until the sewer is completely blocked.

Prohibition of Soft Wood Shade Trees

It seems advisable that in places that are liable

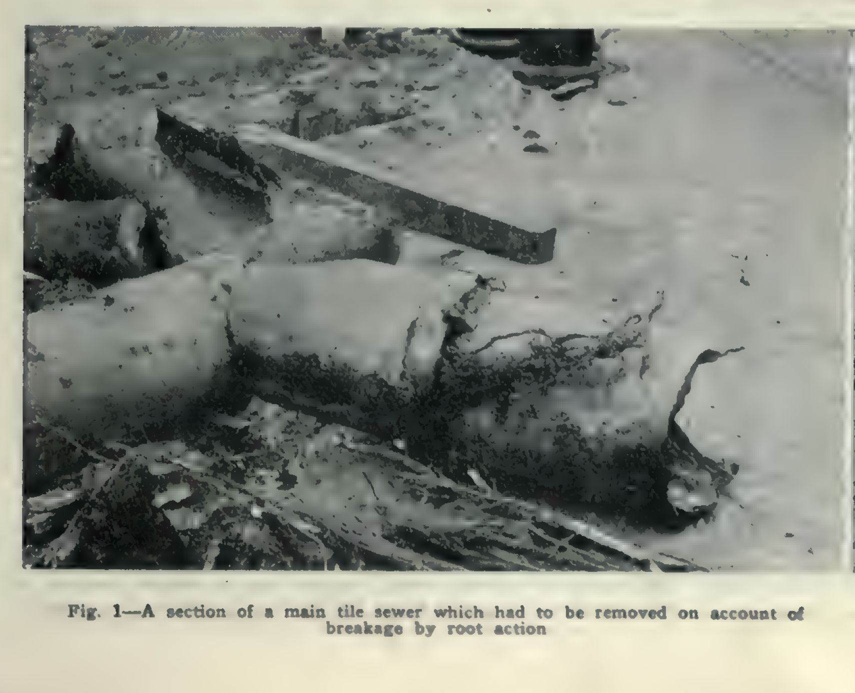


Fig. 1—A section of a main tile sewer which had to be removed on account of breakage by root action

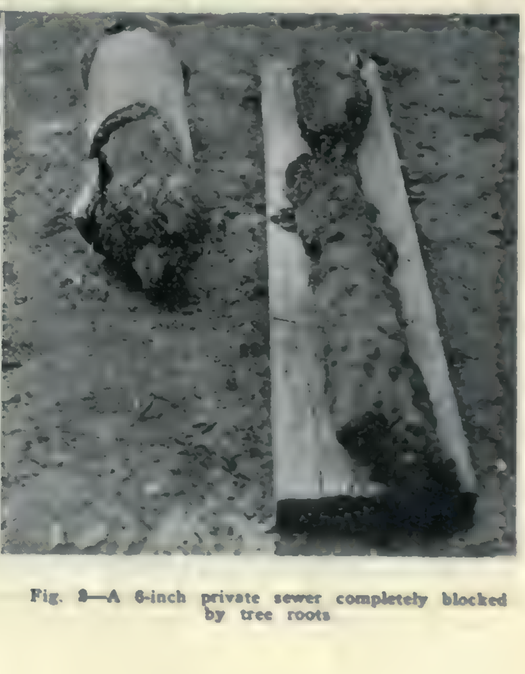


Fig. 2—A 6-inch private sewer completely blocked by tree roots

to be affected, the growing of soft wood shade trees, such as poplars and willows, which require plenty of moisture and send out the greatest volume of roots, should be prohibited. In some enterprising cities, this has already been done, but we regret to say the necessity has not yet been universally recognized and preventive measures adopted.

In Fig. 1 is shown a section of a main tile pipe sewer where roots entered and broke the joint, thus causing the removal of the pipe and repair of the sewer. In Fig. 2 we show a section of a six-inch private drain completely filled with roots. Also in the same cut, a sample of roots taken from a similar pipe. In Fig. 3 is shown how small roots work their way through a neat cement joint. From these three cuts can be seen the seriousness of this problem and the necessity of preventive measures.

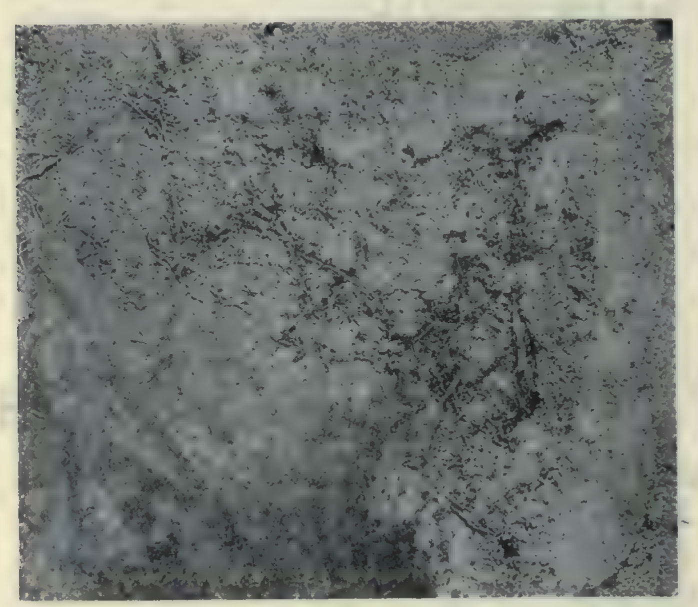


Fig. 3—Small roots working their way through a neat cement joint in a drain. The lower left hand corner of the illustration indicates the original smoothness of the concrete which has been eaten away, as shown in the upper part of the cut, by the roots in their efforts to effect an entrance into the drain.

Bridgeburg, Ont., is Looking for Construction Activity

The Year Promises to be One of Healthy Progress—New Buildings and Public Works Planned

By GARRETT O'CONNOR

Bridgeburg, Ont., a town of 2,500 inhabitants has passed its period of depression in good order, and the immediate future promises healthy progress both on the railways, and in the carrying out of many local improvements of an expensive nature. All the railways in town are not only employing all their permanent employes, but are engaging extra men. The freight cars handled here daily in the yards number about 4,500; and passenger business is also brisk. A by-law lately passed insures the erection of a new town hall to cost about $30,000. The council is earnestly advancing this matter at present, and actual work may be looked for in the near future.

This town adjoins the village of Fort Erie, the dividing line being Gilmore road, running east and west. Sewage is badly needed on both sides of the line, and a fine main sewer, to cost about $40,000, is now being planned by Bridgeburg authorities.

Bridgeburg public schools have been greatly extended in the last few years, but more room is now required, caused in part by the new school age of sixteen. Our high school pupils numbered only 18 in 1918, but now number 65. A by-law has been passed to provide $30,000 for the construction of a 50% addition to the high-school, and an architect is now preparing plans.

We have a large marble-works lying idle on Lewis street, but it has been purchased by a prosperous Buffalo company, the Fedders Manufacturing Company of Black Rock, N. Y., makers of air-plane and automobile radiators, who promise to have 200 men employed before the end of the year. The other factories in town are in good working order, and idle men are few. Of course, we have no demand for men from outside at present. In the near future there is promise that a bridge may be built from Buffalo to Fort Erie, to accommodate vehicle and foot traffic—the state assembly at Albany, N. Y., granted its promoters a charter on Friday March 17. A movement to have the main international bridge rebuilt, double-tracked and provided with carriage and footways has just started, and may bring good results. On the river road, a part of the Niagara Boulevard which passes under the abutment of the international bridge is to be widened this spring by the Niagara Falls Park Commission, and made safe for auto-traffic.

New land has been opened up for good quality residences, land to the north of the town may be taken in, and the year 1922 may be one of general advancement for Bridgeburg.

Strange to say, although this thriving town has a fine water-front on Niagara river, it has no dock or landing wharf although the Dominion Government may be asked to make a grant for one.

Orton and Steinbrenner's Representative

The Orton & Steinbrenner Co., of Chicago and Huntington, manufacturers of locomotive cranes, clam shell and orange peel buckets and coal crushers, have made arrangements with J. Ross Bates, formerly connected with Wonham Bates & Goode Trading Corp., of N. Y. and Boston, to represent them in the New England States and New York City. Mr. Bates has offices at 136 Liberty St., New York City and 128 School St., Watertown, Mass.

Water Works Construction in Trenton, Ont.

The water commissioners of Trenton, Ont., have in mind a considerable program of construction for the coming season. It is proposed to construct a large reservoir, several miles of watermains, increase the supply of water and possibly reconstruct the pumping plant. James, Proctor & Redfern, Limited, consulting engineers, Toronto, have been retained to report on the whole matter.

Work on the canal harbor at Port Weller, Ont., will be, it is announced, well under way by April 1. Dredge, scows and equipment have been brought out of winter storage at Port Dalhousie and a large staff of men is being engaged.

Rinks Built at Surprisingly Low Cost

Arenas at Milton, Grimsby and Cayuga, Ont., Constructed Very Cheaply —Steel Trusses of Light Design with Curved Top and Bottom Chords, Wood Purlins and Wooden Roofs

By H. J. CALDWELL, B.A.Sc.
Engineer, Frank Barber and Associates, Ltd., Toronto

This past winter we have witnessed a great boom in Canada's national winter sport. Hockey arenas were built in a great many towns last year and from the patronage that these rinks have enjoyed it is almost certain that a number of towns will take advantage next year of the excellent opportunities afforded by having such a building as a booster for clean sport and amusement both in summer and winter.

A large number of the old rinks, often unsightly in appearance, have been burned or have collapsed. This, of course, was due to the uncertainty of wood construction with its rapid deterioration. The general idea seems to have been that only very large and expensive rinks could be built with a steel framework, but this idea has now been disproven.

This rink at Milton, Ont., was built for $21,000

Last year the above firm designed and supervised the construction of rinks at Milton, Grimsby and Cayuga, Ont., which have steel colums and roof trusses. The cost of these rinks was low enough to be within the reach of any town and make a sound paying investment. The difficulty seems to have been that the designers have been afraid to attempt the construction of a steel frame building with the amount of money available. These buildings have been proven that such rinks not only can be, but should be, built of steel on account of the permanency of the construction and the fire resisting qualities.

An attempt was also made to eliminate the unsightly appearances that are so prevalent in the old style of rinks. A clubhouse front has been added to these buildings which gives them a more useful and pleasing appearance and transforms them from "eyesores" to real assets.

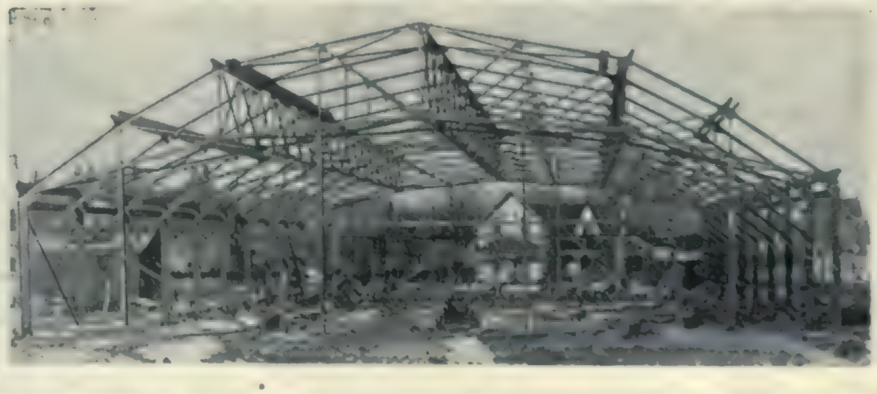
The steelwork in these buildings is also a departure from the ordinary type of roof trusses generally used. The type used adds enormously to the general appearance of the building and the cost is practically the same. The accompanying pictures will illustrate the advantages of a truss of this type. An arched effect is obtained which gives a more spacious appearance to the interior of the building without the bulky, uneconomical appearance of a high circular arched roof. The steelwork nestles into the roof and leaves nothing to attract the eye or interfere in any way with the vision. Such an effect would be impossible with the old type of heavy wooden truss.

$21,000 for the Milton Rink

The Milton arena has 9 trusses, 18′ centre to centre, with a clear span of 90′-0″, steel colums supporting the trusses. The building is 197′ x 92′ with an ice surface 70′ x 175′ and seats for 1,500 people. The end panels are built up of steel columns and beams to support the brick curtain walls. The entire building is built of brick and steel, 192,000 bricks and 60 tons of structural steel being used. The steelwork was fabricated and erected in about five weeks time by the Dominion Bridge Company, Limited, of Toronto. All the work was done in the month of December, and was, therefore, seriously handicapped by the cold weather. The total cost of the building including seats, ice rail, balcony and clubhouse with dressing rooms and refreshment booth was about $21,000.00.

The Cayuga rink has 10 trusses, 20′ centre to centre, and 75′ clear span. The building is 196′ x 77′ with

A construction view of the rink at Cayuga, Ont. The use of light steel trusses keeps the cost down.



an ice surface 60' x 160' and room supplied for 1,200 seats. The trusses are of the same type as were used on the Milton rink. The total weight of steel was 104,520 lbs. and it was fabricated and erected in about five weeks' time by the Standard Steel Construction Company, of Welland, Ontario. The roof is of wood sheathing and heavy prepared roofing with corrugated iron sides and back end. The clubhouse front is of stucco and designed as a memorial to Cayuga's sons who were killed overseas. The total cost of the building without seats, which will be erected next year, was $10,400.00.

The Grimsby Rink

The Grimsby rink has the same steelwork as the Cayuga rink. The building is carried out over five tiers of seats, the steel columns being behind the first row. The columns are really no great hinderance to the view. The building is 203' x 106' with an ice surface 70' x 175' and seats for 2,000. Corrugated sheathing was used on the side walls and back end with stucco clubhouse front and balcony. The cost of the building was about $18,000.00. There is an artificial ice plant in conjunction with the building which assures them of ice at all times. The steel was fabricated and erected by the Hamilton Bridge Works Co., Ltd.

The actual cost of these buildings goes a long way to prove that steel frame structures are very little dearer, if any, than the old type of rinks with wooden trusses which we so often hear of being burnt or blown down.

Chemistry in the Manufacture of Cement

Practical Experience Responsible for Development of Cement Industry—Chemistry to Have More Influence

An address on the "Study of Conditions Causing Disintegration of Cement Under Acceleration Tests" was given by Mr. A. G. Fleming, chief chemist of the Canada Cement Company, at a meeting of the Montreal section of the Society of Chemical Industry on March 17th. After a brief history of portland cement, Mr. Fleming dealt with the methods of testing the soundness of cement, referring to the boil test, autoclave test, LeChatelier's test, cold water test and microscopic test. He also referred to the theories of investigators regarding the causes of failures in accelerated or boil tests. Regarding the boil test, there had been, he said, great controversy as to its value and faults as a measure of quality of a portland cement, but the test was still in common use and was not likely to be soon discarded, since nothing had been devised which was as simple and convincing to those who felt that the boil or steam test directed attention to weak spots in a cement which should be further observed and guarded against. The manufacturers of cement found it a useful gauge of the essential qualities of their product, for in most cases, if cement passed this test, it had a good chance of passing any other test to which it might be subjected, although they felt that the test was unnecessarily severe and would reject two good cements for every bad one.

Mr. Fleming then gave the results of comparative tests made in the Canada Cement Company's laboratories with the object primarily of noting the relative effects of the ordinary boil tests on test pats stored under the different conditions of storage in dry air, moist air, and under water. He pointed out that the tests demonstrated that cements of almost identical chemical composition can be sound or unsound in test. Mr. Fleming stated that the percentage composition of the constituents present in the average portland cement gave very little guidance as to its probable behaviour under accelerated tests.

The speaker referred at considerable length to the difference between the "wet" and "dry" processes of manufacture. In going from the "wet" process, wherein marl and clay were used, to the "dry" process, using limestone and clay, it was evident that with the same fineness of raw mixture in the "dry" as was possible in the "wet," it was possible to produce sound cement and of equally as good quality. The solution of the problem of fine grinding was a matter of great concern until it was realized that it was simply a case of dry and hot materials, when the grinding capacity was very much increased and a perfectly sound clinker was obtained. The ability of the cement clinker to pass the accelerated test for soundness depended greatly on the fineness of the mixture entering the kiln. With some limestone and clay mixtures, it was necessary to grind the mixture extremely fine, and great improvement in the process, both from the point of quality and economy of production, had been brought about by the use of improved pulverising machinery.

Generally speaking, it had been found that the best and surest way to increase the production of portland cement and lower the cost of manufacture was to do everything possible to increase the quality of the cement. In other words, the cement that suited the customer best was the cheapest to manufacture. The facilities provided for analysis of the materials previous to making the mix were now much better than formerly, and the mixture going to the kilns of the various plants was consistently pretty much the same from hour to hour and day to day. Up to the present, a knowledge of the chemistry of cement making had played but a minor part in the development of the industry. Practical experience and engineering practice were largely responsible for the development of the industry to its present stage of perfection, but in the future, chemistry should be of more real assistance than it had been in the past. The present knowledge concerning the chemistry of cement should be practically applied, if that were possible, but there should be no attempt made for some time to make any change in the composition of cement which would interfere with standard specifications.

"The Standard Steel Construction Company of Welland, Ontario, have recently been appointed sole Canadian representatives for the sale and distribution of the well known products of the Irving Iron Works of New York City consisting of steel floor gratings and Safesteps. Their floor gratings are used almost exclusively in the extensive subway work in the New York Metropolitan district."

The village council of Thornbury, Ont., are considering the installation of a waterworks system and have retained James, Proctor & Redfern, Limited, Toronto, to report on the matter.

New Gas Works at Victoria, B. C. Contain Latest Improvements

A Description of the Recently Completed Plant Installed by an English Company—Manual Labor Eliminated Almost Completely to Keep Down Cost of Production

By the Contract Record's Victoria, B.C., correspondent

After considerably more than a year of preliminary work and actual construction, the new gas plant at Victoria, B. C., which has been built by the West Gas Improvement Co., of Manchester, England, is practically ready for its formal opening when it will be put into regular service, the old banks of horizontal retorts, hand-fired, which have been in use for many years, being from that time a reserve only.

It is only a comparatively few years ago that with the coming in of the electric light as the popular lighting medium it was said that the days of the gas plant were numbered. A gas plant is necessarily bulky, the distributing system as expensive as that of a water supply system, and the distillation of the gas from coal entails many problems of handling of material in bulk which promised solution, as was then thought, by the simple process of elimination. But by a skillful process of adaptation of their product to the changing needs of the public, and by educating the public to other uses of gas which at that time were hardly thought of, the gas companies are to-day not merely surviving, but are growing, and are more highly organized and possessed of more efficient tools than ever before in the history of the industry.

Some of the apparatus devised in the early days of the gas industry has been found by long experience to be so perfectly adapted to its purpose as to be susceptible of little improvement, but this is the case principally as regards certain of the details which are less known to the public than the two outstanding and characteristic features which have made the gas works a prominent feature of every town, large or small, so privileged as to possess one. Reference is, of course, to the retort house, so well known by its rows of smokestacks, and to the conspicuous cylindrical gasometers or storage tanks whose function is also to compensate for fluctuations in demand and to some extent to regulate the pressure in the gas mains.

Most Modern Retort House

Time has brought many changes in the design and construction of these two parts of the central gas plant, and the advance of the art of retort building is well exemplified in the now practically complete retort house built in Victoria by the West Gas Improvement Company for the Victoria Gas Company. Every detail has been included that experience has shown to bring increased efficiency, and this plant, while not the largest built by this firm in Canada, is perhaps the most complete and modern of its type yet put into operation in this country.

The object of the management being to cheapen the cost of producing gas as much as possible, this plant has been so designed as to eliminate almost completely manual labor. From the time the scows laden with coal arrive at the gas company's unloading wharf, until the coke is finally removed in trolleys from the bottom of the retorts, it is handled entirely by machinery, a very complete system of storage and handling having been worked out by the superintendent, Mr. F. H. Hewlings, and his construction engineer, Mr. K. M. Chadwick, A. M. E. I. C. Coal will be unloaded from the scows by means of a clamshell bucket operated from a stiff-leg derrick, and is dropped into a hopper at the end of a reinforced concrete trestle which marks the centre of the coal storage pile, the system of storage in open

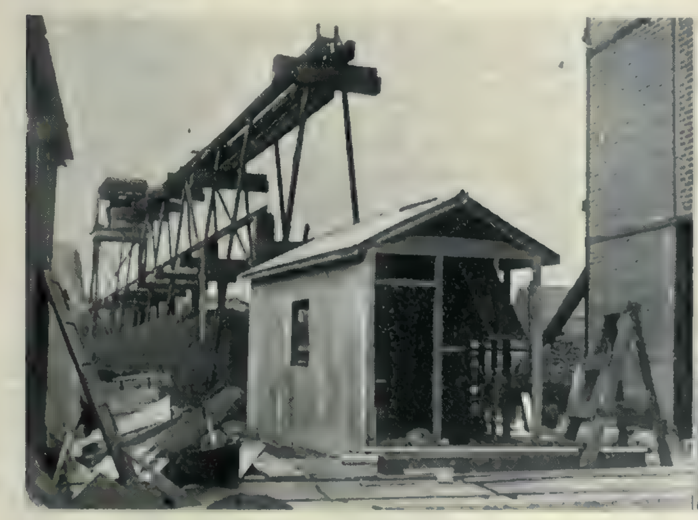


Fig. 1—Discharge end of conveyor from stock pile, conveying coal to grizzly leading to an elevator in the retort house

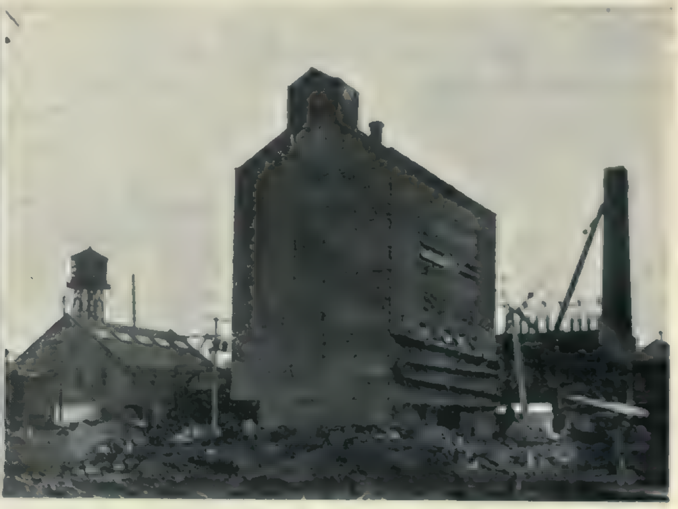


Fig. 2—General view of new retort house, Victoria gas works

pile having been adopted as most economical. This trestle carries an automatic distributing mechanism in the form of a trolley operated entirely by gravity the coal being loaded into the car from the hopper before mentioned, run down the incline trestle as far as may be required, where it is automatically dumped and the car returned to its place under the hopper by means of power which it has itself stored, through a system of cables and a counterweight, during its run down loaded.

Coal Handling Equipment

Underground and directly under the trestle which has just been described is a reinforced concrete tunnel with openings spaced at intervals along its length in the roof, through which the coal is admitted as required. Suitable gates or valves are installed here for control, which are operated by hand as required. On the opening of any one of the valves, the coal from the pile is allowed to drop on to a belt conveyor which runs the length of the tunnel and is carried along to the end nearest the retort house, where it is raised above the ground level and discharged through a spout which is shown in the illustration (fig. 1) and drops on to a grizzly—a gridiron arrangement of steel bars which acts as a screen and prevents the further passage of large lumps of coal. Dropping through this screen, the fine coal passes to an elevator which carries it directly to the top of the retort house, where it is stored for use as required in the retorts themselves

Unlike the horizontal gas retorts which are most familar and which require periodical charging and opening to remove the coke, an operation which is carried out by hand in the old plant, the West vertical retorts are continuous in operation and automatically dispose of the coke formed at the bottom of the retort. A charge is made every two or three hours by simply opening a valve which connects with the storage hopper at the top of the building and an automatic mechanism, in the shape of a huge worm or spiral with a diameter of between three and four feet, operates to remove the coke as formed, depositing it in a small hopper at the base of each retort, whence it is dropped into a car which runs on tracks underneath the retorts, when the gates are opened by the attendant. A feature worthy of note is that whereas in the ordinary gas plant the coke is drawn at a white heat, causing uncomfortable and even dangerous working conditions for the attendants, in this plant much of the heat in the coke which would ordinarily be wasted is absorbed by utilization for the purpose of generating steam, a considerable quantity of which is required in the manufacture of the gas.

Coke For Heating the Retorts

The coke produced in the gas manufacture will be stored in elevated hoppers which are yet to be constructed. These will accommodate about two days' run of coke, which is in turn used for fuel for heating the retorts themselves. As at present operated, the gas company produces coke in excess of its own requirements, and in places where an industrial demand for coke exists it is possible to profitably dispose of this surplus. In a residental city, however, this is more difficult and the operators' ideal is to, in their own parlance, "run to complete gasification" which means that the distillation process will be carried so far in the retorts that only sufficient coke will be produced to cope with the company's own requirements for the heating of the retorts.

Gas is no longer used to any great extent for lighting purposes, although in the case of most of the existing gas works the lighting of the community they served was the field they had in view when operation was first started and for a good many years thereafter. The present day purpose of gas is almost entirely for heating, and its use in various industrial operations is growing very rapidly as its convenience is becoming better and more generally known. The gas industry has been engaged in a fight for its existence, and the production of such plants as the one just described is a proof that the fight has been so successfully waged as to make the industry a safe and profitable investment. The problem of the efficient central plant appears to be solved in a manner which leaves comparatively little room for improvement, but much still remains to be done to make the product easily and cheaply available to a larger circle of users. The distributing system, as already suggested, is an expensive one, due to the fact that gas must be used at an extremely low pressure—less than one-half pound to the square inch. This necessitates large pipes, and as for the sake of durability the mains must be of cast iron, the expense of installation is obvious. Development seems to be indicated along the line of distributing the gas at what the gas manufacturer would consider extremely high pressure, and providing means for reducing this pressure at the consumer's meter. And for the outlying would-be consumers one is inclined to give public voice to the pathetic request overheard one day recently at the wicket in the gas company's office "Don't you sell gas in tanks? This is probably not at all an original idea, but seems to hold practical possibilities for a considerable extension of the business into fields at present economically inaccessible to the ordinary distributing pipes.

The Future in the Gas Industry

But the big thing which the future holds for the gas manufacturing industry, after the problem of economical distribution is satisfactorily solved, lies in the still further cheapening of the product by reducing to the minimum the handling charges on coal. One ton of coal produces an average of ten thousand cubic feet of gas. It costs at the present time between $3.00 and $4.00 to bring a ton of coal to the surface, and that same ton of coal has to be sold in the cities at $11.50 which shows a margin of $7.50 to cover the profits of the various hands through which coal must needs pass on its way to the small consumer plus the actual carrying charges, which are so heavy that no one is making an exorbitant profit on the business. Keeping in view the amount of actual manual labor which is represented in this, with the shipping and reshipping which is involved before the coal's ultimate destination is reached, and adding to that cost of removing the ashes resulting from the widespread consumption of coal in its raw state, it must be obvious that it is most conservative to estimate that at least two-thirds of this overhead of $7.50 would be cut off if gas were sold at the mines through small, high pressure trunk mains with a high pressure distributing system as already described serving practically every part of the community.

Lessons from a Fatal Derrick Accident

Disaster Caused by an Unnecessarily Large Derrick, Improperly Guyed and Used for Dragging—Proper Anchoring is Most Important

Derrick disasters are of quite frequent occurrence, many of them of serious proportions and some ending in fatalities. In the majority of cases, the accidents are not due to any inherent defect in the equipment itself but to slip-shod rigging or poor operation. The effect of these factors and the possibilities they present of causing disasters are very clearly explained in "The Travellers Standard" a house organ of the Travellers Insurance Co. This article contains such excellent council that it is reprinted herewith.

Derricks are in constant use, in great numbers; and every once in a while something goes wrong with one of them, or some part of the equipment fails, with the result that persons are killed or injured and property is destroyed. Two such accidents which have recently come to our notice emphasize the importance of taking every possible precaution in connection with the installation, operation, and equipment of derricks. In one of these accidents four men were hurt, and in the second one, which we shall describe in some detail, one man was killed and four others were injured.

The fatal accident was caused by the fall of a wooden guy derrick which had been in place but a day or two. This was to have been used for setting the steel in a building 65 feet long and 35 feet wide, which was in the first stages of construction. The derrick mast was 80 feet high and the boom was 70 feet long. In order to handle the work advantageously, the derrick was set up at a point about midway between the two side walls, and approximately 20 feet forward from the rear end of the building. Six guys were provided, as is customary in such cases, and two of them were secured to anchors embedded in the concrete at the two rear corners of the building. Arranged in this way, the distance from the foot of the derrick to each rear corner was only about 25 feet, and therefore, the two rear guys were at an angle of approximately 17½ degrees from the vertical, which is far steeper than is desirable or customary.

The anchors for the guys were composed of wire rope, ⅝ of an inch in diameter, which was embedded in the concrete building foundations, as previously stated. There were three turns or loops of the wire rope for each anchor, and it was the intention to provide a fastening equal in strength to the combined strength of three cables, each ⅝ of an inch in diameter.

Derrick Used for Dragging

At the time of the accident the derrick was being used to drag along the street, in front of the building site, a grillage beam weighing approximately three tons, and composed of two 20-inch I-beams joined together by riveting angle plates to them. This was being done to bring the beam into a position from which it could be hoisted to its place in the building. It was necessary to have the derrick boom in a nearly horizontal position to do this work, and as the boom was extended toward the front of the building the greater part of the strain was concentrated on the two rear guys. As a result, the wire-rope anchors for these two guys parted and the derrick fell, killing one man and injuring four others, as stated above.

There are lessons to be learned from nearly every accident, and in order to prevent similar mishaps, as far as possible, it is desirable to state the cause of those that have already occurred whenever these causes can be discovered. The added publicity that this course involves is usually distasteful to the person or persons on whom the responsibility for a particular accident rests; but so long as the purpose in view is laudable, and the discussion is conducted temperately and without prejudice or personalities, and is confined to the presentation of safety principles, the man who made the mistake (if any were indeed made) should be entirely willing to have the public profit by the experience.

With this thought in mind we wish to call attention to several conditions which indicate, according to the information that we have concerning this accident, that lack of judgment was the underlying cause of the unfortunate occurrence now under consideration.

Unnecessarily Large

In the first place, it appears that the derrick selected for this work was unnecessarily large. It was of 15 tons capacity, although it is said that the heaviest object to be handled would not have exceeded three tons in weight. There would perhaps have been no objection to the use of this derrick on a job covering a larger area, except that it might have been considered inefficient and wasteful of power to use such heavy apparatus for comparatively light loads. In the present case, however, with a limited area for extending the derrick guys, the use of a mast 80 feet in height required the installation of the guys (particularly the two rear guys) at a dangerously steep inclination, which greatly reduced their strength.

Secondly, we do not approve of the practice (which is more or less common) of using a derrick for dragging things along on the ground. The resulting load may or may not be greater that the actual weight of the object, but in any event this procedure is likely to subject parts of the hoisting equipment to stresses which were not contemplated nor provided for in the installation of the derrick. Structural members and other objects should be moved on rollers or by means of suitable apparatus of some other kind.

Finally, the method of anchoring the guys that was used in the case under discussion is not the best or the safest. Wire-rope anchorages of this kind can be installed so that there will be little likelihood of their pulling out of the concrete, provided sufficient time is allowed for the concrete to set thoroughly. It is extremely difficult, however, and probably impossible, to install an anchor composed of several loops or turns of wire rope in such a way as to divide the load equally on each loop. The loops are likely to vary somewhat in length, and even if this variation is extremely slight the load is always thrown upon the shortest one first; and unless the job were done with the greatest care and skill, and the several turns of rope stretched by exactly the same amount, the short loop might have to carry the entire load. Furthermore, if the loops are short the strain to which they are subjected may greatly exceed the weight of the load, in accordance with the principle involved in the use of slings, where the angle which the sides of a sling make with the load is an exceedingly important factor in calculating the actual stress that the sling has to sustain.

Steel for Johnson St. Bridge, Victoria, is Now Being Erected

The Canadian Bridge Co. are Now Working on the New Bascule Structure—Tenders for Railway Section are Above Estimate—Concreting is Proceeding

By the Contract Record's Victoria, B.C., correspondent

Work on the steel for the new bascule bridge at Victoria has been commenced by the contractors, the Canadian Bridge Co., of Walkerville, Ont. Their superintendent, Mr. W. O'Brien, arrived on the job early in February, and has been busy with the preliminaries including the erection of a temporary trestle leading from the railway tracks of the Esquimalt and Nanaimo Railway Co. to the trunnion pier. This trestle follows very nearly the line which will be taken by the permanent tracks and is being used by the bridge company's travelling crane.

Concreting has been proceeding on the base of the rest pier at the west end of the bascule span, and as soon as this is set, the crib will be pumped out and the forms for the pier proper will be erected. Work could be proceeding on the large amount of reinforced concrete to be contained in the approach at the west end, but this portion of the work is being deferred pending the settlement of certain outstanding differences which have developed between the provincial and Dominion government authorities concerned.

The first girder going into place on the Johnson St. bridge, Victoria

Tenders were opened on March 3 for the remaining portion of the steel work, viz., the railway section of the bascule span. The figures were as follows:—

The first girder is 113 ft. long over all, 10 ft. deep, and weighs 56 tons

Canadian Bridge Co.	
Fabrication and erection	$213,400
Fabrication only	159,900
J. Coughlan & Sons (Vancouver)	
Fabrication and erection	212,500
Fabrication only	175,00
Sir William Arrol Co., (Glasgow)	
Fabrication only	186,156
Dominion Bridge Company	
Fabrication and erection	253,750
Hamilton Bridge Company	
Fabrication and erection	249,600
Fabrication only	186,600
City engineer, tender for erection by day labor	75,000

The lowest figure for the complete job is that of J. Coughlan & Sons at $212,500, but the work has not as yet been awarded for the reason that this figure exceeds by $50,000 the amount allowed by the city engineer in estimating for this portion of the work. It seems probable that it may be necessary to submit a by-law to the electors for the raising of the additional sum of money, but it is likely that new tenders will be called for before this action is taken, in the hope that a second bidding would result in the receipt of a tender within the amount already authorized.

Purification of Water Supplies

Refinements in the Composition of Filtration Equipment—The Value of Chlorine Disinfection—Purifying Water for Industrial Uses —Making Small Town Plants Operate Satisfactorily

By **JAMES O. MEADOWS**
Chief Engineer, Montreal Water & Power Co.
Before Montreal Section of the Society of Chemical Research.

The source of all water is in the rain which falls. In falling it washes the air and absorbs some of the gases contained in the air. After the water reaches the earth's surface many things can and do happen to it. Some of it evaporates and is drawn up into the higher altitudes; some percolates into the soil and joins the ground water and the balance is known as run-off water and enters the natural water courses—our lakes and rivers.

Considering a unit volume of water which falls to the earth as rain, many things may and do happen to it. It may fall on a marsh area and remain in contact with the rank vegetable growth. Here it will have its organic content added to and will be colored by the organic acids and possibly by soluble iron salts. It will finally be flushed out of the marshy area and enter a water course where it may join waters of an entirely different character, such as ground waters carrying varying amounts of matter in suspension. It may also be diluted with animal and trade wastes which will alter its composition and increase its bacterial content. The character of the soil and rock formation on a watershed determines the nature of a natural water to a high degree but in some cases the polluting factors may be so large as to greatly change the original character of the water.

When water purification is mentioned the average layman thinks of municipal water filtration or purification because it is this branch that he has been most interested in and because more has been written about it than any other branch of the work. Municipal water purification has had a remarkable growth in the past fifteen or twenty years and many cities which formerly had a high typhoid rate now have practical immunity from water borne typhoid.

Dry Feed Chemical Machine

Water purification plant construction has become pretty well standardized now and the improvements noted are little refinements which facilitate the work and make the final results more satisfactory. A rather recent development is the dry feed chemical machine. Formerly the chemicals used in water purification were put in solution and in this state applied to the water. The dry feed machine is arranged to apply the fine granular or powdered chemical to the water to be purified. The several varieties of dry feed machines have various devices for continuously measuring the required amount of chemical and their operation is either manually or automatically controlled. The solution type of chemical feed is expensive to construct and the parts are subject to considerable corrosive action, whereas the dry feed apparatus is cheaper, takes up less space and shows less general depreciation.

Generally speaking, the mechanical or rapid sand type of filtration plant has received the greatest measure of approval both in this country and in the United States. This is due to several reasons, among which may be mentioned, its greater ability to handle turbid and highly colored waters, its lower original cost and its adaptability for use in cold climates.

Rapid sand filtration may be said to consist of three stages or processes. The first stage is the application of the chemical or coagulant to the raw water to be treated. There are various ways in which the coagulant is applied but in all well designed plants it is essential that the chemical be applied in an uninterrupted manner and proportional to the amount of water filtered.

The second stage in the process of rapid sand filtration is the coagulation or sedimentation stage. The water after being treated with the coagulant passes to large basins where the reaction between the coagulant and the carbonates and bi-carbonates present in the water takes place and a major portion of the precipitate of aluminum hydroxide settles out. The precipitate in forming removes coloring matter from the water and entangles bacterial life present in the supply. The flow of water through the coagulation basin is very slow but continuous, and a well designed basin should effect 70% bacterial removal. Natural waters differ greatly and on this account it is necessary that the coagulation basin be designed with care to handle the water to be purified. Some water reacts quickly to the coagulant, some slowly; with some waters the precipitate is heavy and tough and settles out readily; with others the precipitate is light and fragile and settles out slowly. It is necessary to know all these facts about a water before the design of a coagulation basin can be considered. Some basins that are designed to handle very turbid waters are arranged in two sections, the water going to the first section without the addition of the coagulant, which is not applied until the water passes to the second section. In the first section of the basin the heavy suspended matter settles out and the water comes to the last section with a lower turbidity. This arrangement is also economical as regards coagulant consumption, because the suspended matter will absorb some of the chemical and more will be required than is necessary for treating the less turbid water which comes to the second section.

Sand Filters

The third and final stage in rapid sand filtration consists in the filtering of the water through the sand filters. The sand filter is usually 27 in. to 30 in. in depth and is supported on a bed of graded gravel. Filter sand usually has an effective size of .37 to .48 mm. and a uniformity coefficient of 1.6. The sand filter is really the finisher and it removes the aluminum hydrate that has not settled out in the coagulation basin and further lowers the bacterial content of the applied water. The rate of filtration through the sand bed is controlled by proper rate control apparatus and the normal rate for municipal work is 1.66 gals. per sq. ft. per minute. Loss of head gauges are provided to indicate the frictional loss of the water in its passage through the filter bed and strainer system and they also show when the filter is dirty and requires washing.

Filters are washed by reversing the flow, the spent wash water being carried off through gutters placed above the sand bed. There are two systems for washing filters. In one air under 3 to 4 pounds pressure is forced through the bed from the bottom, the idea being to agitate the filter bed and loosen the dirt that is adhering to the filtering material. After the air application the filter bed is washed with a reverse flow of water at a rate about four times in excess of the filtering rate. The rate of wash water application is sufficient to raise the sand bed four or five inches and hold it in this suspended condition throughout the washing period. The second method of filter washing is known as the high velocity wash and depends solely upon the use of water but at a rate nearly double the water application used for the air and water wash. When this wash is employed the sand suspension is greater and the wash water gutters are larger and are also located higher above the surface of the sand bed.

Chlorine Sterilization

Practically all water purification plants are now equipped with chlorine disinfection or sterilization apparatus by means of which the filtered water is treated with a small dose of chlorine. Liquid chlorine in steel cylinders is connected to a chlorine control machine which is so designed that varying amounts of chlorine can be applied to the water to be treated. The usual dose is from 2 to 3 lbs. per million gallons. It is argued by some that, provided the filtration is satisfactory, chlorine treatment is not necessary but those who take this attitude are not well acquainted with mechanical equipment and the inability of those in charge to keep this apparatus at maximum efficiency at all times. They also neglect the personal factor, which is ever present at a water purification plant and which accounts more than anything else for the irregularities that occur. The chlorine treatment is inexpensive and is also an added factor of safety between the raw water and the consumer and its widespread use certainly has demonstrated the value of the process. Some of the larger water purification plants produce their own chlorine gas by the electroysis of salt and apply the gas to the water as produced. The chlorine treatment alone is also used to purify a large number of public water supplies but its use in this manner is not encouraged. Most natural waters show considerable seasonable variation and it is very difficult to so vary the chlorine application as to secure satisfactory results at all times. Chlorine also only acts as a surface disinfectant and when a water contains matter in suspension the bacteria enclosed in the particles are not acted upon by the gas.

The pressure type of rapid sand filter differs from the regular type filter in that the filtering material is placed in a closed steel tank and the whole system is under pressure. The pressure system also lacks the coagulation basin which is so prominent in the gravity type. Pressure filters are suitable for use on a quick coagulating water and are much used by industrial concerns.

Purification of Industrial Waters

We too often think of water purification as a process employed to make water safe for drinking purposes and do not stop to realize the enormous quantities of water used for industrial purposes where no exacting standard as to potability need be set. Some industrial establishments only require that the bulk of the suspended matter be removed from the water to make it fit for their industrial use. Such concerns are the pulp, kraft and news print mills, rubber mills and others. Water passed through revolving sceens will have a large per cent. of the suspended matter removed and will be satisfactory for many industrial uses. Screens of this type are automatically cleaned by a jet of water which removes the dirt from the screen and carries it off through a trough.

Other industrial users require a water practically free from suspended matter but do not object to color in the water. Such concerns can secure the water they desire by simply filtering the water without the use of a coagulant and at rates considerably in excess of the normal rate. Still other concerns require a well clarified water with practically all the suspended matter removed but do not require a high degree of bacterial purification. Such requirements can be met with either the gravity or pressure type filter, using a coagulant to remove color and suspended matter and operating the filter at a rate considerably above the normal domestic rate.

The water requirements of some industrial plants are very exacting and the purification plant is called upon to deliver a water every bit as good as required for municipal service. The Eastman Kodak Company is in the latter classification and this company is at present constructing a large slow sand filter plant which is guaranteed to deliver a water of very high quality. The Kodak Company is very exacting regarding the slightest amount of matter in suspension in the purified water, because in their manufacturing process this foreign matter injures their product.

Industrial concerns are appreciating more and more the value of a suitable water for their manufacturing processes and many have purified their supplies to the degree required for their uses. In the past, industrial establishments purchased water purification equipment in a hit or miss manner and many of the old plants are everything that they should not be. In other cases the plant installed will turn out a satisfactory water; in fact, the degree of purification is higher than required and a considerable saving could have been effected by installing a plant at lower capital and operating cost. Now these concerns are profiting by their mistakes of the past and are obtaining good advice before they embark on new water purification expenditures.

Competent Supervision for Small Town Plants

The water purification plants that are described in technical papers and journals are usually the large plants under expert supervision. The results obtained by these purification plants are almost without exception good, because nothing is left to chance and those in charge understand their work and know how to get results. But the small town plant is in another classification. When its construction is completed it is usually turned over to the engineer in charge of the local pumping station, who in most cases has never seen a filter plant before. He receives some instruction from the erecting engineer, who installs the filter equipment, and from the board of health engineer, but on the whole his training is of such short duration that he is left in a much befuddled state. It is no wonder that the water turned out from such a purification plant is of uncertain quality; one day it will be good; another day it will be fair and on the following day it may be dangerous. Parts of the filter equipment get out of adjustment and are neglected and in a short time the plant is not capable of producing a satisfactory water and often the coagulant application is wrong and the water is not properly clarified. The only way to secure satisfactory operation of these small filter plants is to provide proper supervision but the municipalities cannot afford to pay for the full time services of a competent man.

It has been demonstrated that the operation of a small filter plant can be made efficient when the operation is under the direction of a competent man who will visit the plant two or three times each month. On these visits he will collect series of water samples for analysis; he will train the filter operators; will see that all parts of the plant are in good working order and will check over the daily record sheets kept at the filter plant. It is not claimed that such part time direction is equal to full time supervision but it is surprising to note how much better the results are from a plant so operated when compared with the same plant's operation before the supervision started, also when compared to other plants which do not receive intelligent direction. Water purification work is a specialized work and plant operation often suffers from the advice of a local doctor who sets himself up as an authority. In a somewhat similar manner injury is done by general commercial laboratories who advise on water purification plant operation and correction without having an adequate knowledge of the subject.

Water Softening

Water purification also embraces the subject of water softening. The old standard method of water softening consisted of adding lime or lime and soda to a water to effect the softening. The chemicals were applied to the water in the required amounts and the water was then well mixed, after which it passed to large reaction basins where the precipitate settled out. In some cases the water was drawn direct from the basins and in others the softened water was first passed through filters to remove suspended matter. By this process the hardness is reduced to about four grains per gallon by the soap method.

During the past ten or twelve years the zeolite process of water softening has come to the fore. Zeolite is a sodium aluminum silicate and is a base exchange mineral, or in other words, it has the ability to exchange its sodium base with the calcium and magnesium present in the water and when the exchange is complete the zeolite can be regenerated with a brine solution and the sodium base restored to the softening mineral. There are a few natural zeolite deposits from which the mineral is obtained and after purifying the product is suitable for commercial use. Zeolite mineral is also manufactured by fusing together certain chemicals and minerals and the artificial product so obtained closely resembles the natural product in its properties.

Simplicity of the Zeolite Method

The great value of the zeolite method of water softening lies in the simplicity of operation of the process and the high degree of softening obtained, for with this softener almost zero hardness water can be obtained. A zeolite water softener plant closely resembles a pressure filter installation. The closed tank contains the zeolite mineral and the water in passing through this material is softened. When the mineral has become nearly exhausted the unit is cut out of service for regeneration, which consists of back washing the zeolite with a brine solution and then allowing the brine to remain in contact with the mineral for several hours, usually over night. After regeneration the excess brine is washed from the zeolite and the softener is again ready for service.

Recently hydrogen ion determinations have assumed an important place in analytical water work. Formerly the acidity and alkalinity of a water was determined by fiftieth normal solutions and the water was said to be either an acid or alkaline water according to this titration. Hydroden ion determinations, which measure the amount of dissociation, show us that a water which may be classed alkaline by the old method by the alkalinity determination is in reality an acid water because of the hydrogen ion dissociation or its equivalent. Advantage of this method has been taken in water purification to determine the most favorable point for coagulation and to date some work has been done which shows a good deal of promise. The reaction of bacteriological culture media is also being adjusted to a hydrogen ion value and a media of more definite reaction is being obtained.

Action of Ground Waters on Concrete Sewer Pipe

Consulting Chemist, in Letter to the Contract Record, Claims That the Use of Such Pipe is a Source of Trouble

Editor, Contract Record:

In the early days of the cement industry it was considered good form in contracting circles to lay the blame for all failures to "bad cement". To run down the real cause of these failures was one of the duties of the writer during the period he served as chemist for a number of cement manufacturing plants. During some fifteen years of this work many interesting and instructive facts have turned up that have an important bearing on the practical use of cement in various types of construction work and in many branches of industry.

The chemistry and mechanics of cement manufacture has reached such a state of perfection that one seldom hears of "bad cement" any more. Instead of laying all troubles to the cement the tendency is nowadays to put the material to innumerable uses and to expect too much of it. An immense amount of time, energy and expense has been spent in developing new and strange uses for cement. (see Growth of the Cement Industry on the Pacific Coast, by C. A. Newhall in Proc. Pacific Northwest Society of Engineers Vol. XII, No. 2). Being trained in the chemical end of the cement business as well as in the various uses of the material, the writer long ago recognized that there were a number of very definite limitations to the use of cement.

Cement concrete is not always the permanent rock-like material it appears to be. The cement that binds together the mineral aggregate is a very complex chemical compound or more accurately a mixture of chemical compounds. Under some well recognized conditions these compounds, instead of grouping themselves into stable forms, make very unstable compounds. Under any condition the cement is easily acted on by many weak mineral and organic acids. It is always subject to volume changes due to wetting and drying as it tends to absorb water like a glue. The permanence of the average concrete structure is due entirely to the mass of the concrete preventing the various common destructive agents reaching the main body of the cement. Surface destruction may take place but the action soon reaches a limit and slows down or stops entirely. Thin walled structures or structures made of porous concrete can never be called permanent in that the destructive agents may at any time gain access to the cement on the inner parts as well as to the cement on the surface.

Concrete Pipe Easily Destroyed

One of the most dangerous uses to which cement is now put is in the construction of sewer pipe. These thin walled structures offer ideal conditions for the action of disintegrating agents. It is mechanically impossible to make a cement pipe dense enough to completely eliminate capillary percolation of ground waters. Hence, the cement of the pipe is always subject to any disintegrating action that may arise from acids or salts that may be present in the ground water. Thus even the most carefully made cement pipe is certain to go to pieces sooner or later if the surrounding ground water contains acids or salts.

Some eight years ago the writer was retained to look into the failure of many sections of cement drain tile that had been in the ground for a relatively short time. This was a carefully made machine tile and the manufacturers were local people with a big business future before them. Thus the manufacturer was as anxious to get to the bottom of the trouble as was the buyer of the tile.

A study of the situation showed conclusively that the tile had failed on account of the cement having been removed in large part. In many places the tile had been reduced to a streak of sand and gravel. In other places the cement had been eaten away from the outside of the pipe leaving only a layer of sand around a thin core of pipe. There was little sign of the pipe having been "eaten" away from the inside, the disintegration always being most marked on the outer part of the pipe. It was also noted that pipe laid in clay pockets was as sound as when first laid, disintegration taking place in pipe laid in sandy or loose soil only. We at first thought that this disintegration might have been due to salts in the ground water but investigation showed that there was nothing unusual in this water other than a high content of "soil acids." Just what these acids were was not established at the time.

Failures in Vancouver

Later on in 1918 the writer was called on to investigate the cement sewer pipe that had been laid in Vancouver B. C. Here we found a similar action under way as in the case of the drain tile just mentioned. The outside of the sewer pipe was in many places pitted and eaten away. This action was definitely traced to the removal of the lime of the cement by ground water that was highly charged with carbonic acid. The lime of the cement is easily soluble in carbonic acid water, forming bicarbonate of lime which is quite soluble.

We predicted that it was only a matter of time before the cement sewer pipe in Vancouver would begin to collapse. This prediction has now been fully justified. In August of 1921, a section of 10" cement pipe in the lane off of Pt. Grey Road between Larch and Trafalgar Sts. collapsed. This pipe was placed in 1910 and hence has been in use for 11 years. At about the same time a similar failure occurred in the cement pipe in Cambridge St.

In a report on the Disintegration of Concrete in Railway Tunnel Linings, (Proc. Pacific Northwest Society of Engineers, Vol. XV, No. 4—C. A. Newhall the writer pointed out that many years may elapse between the time a concrete structure is built and the time when disintegration may begin to become apparent. In the case of the tunnel linings examined the disintegration was due chiefly to a chemical action and became apparent only after some twenty five years. In the case of the thin section of a drain tile or a sewer pipe the disintegration may become apparent much sooner.

The time depends, of course, on the density of the concrete and its mass. Also on the nature of the dissolving or disintegrating agent in the water. A massive structure like a tunnel lining may never develop disintegration to such an extent as to completely destroy its usefulness. On the other hand a thin walled structure like a cement sewer pipe may be quickly and completely destroyed, this seriously endangering the health of a community.

It should be noted here that it took eleven years for the sewer in the Point Grey Road Alley of Vancouver to reach the point where a failure took place. Eleven years ago very few people recognized the inherent weakness of this use for cement. The slogan "Concrete for Permanence" was held to be universally true. Hence, the engineering profession can hardly be held to blame for these failures of concrete sewer pipe. Neither can they be held accountable for a lot more failures that will certainly take place in the next few years.

However, any engineer that sanctions the use of cement sewer pipe and drain tile in the future is surely laying up certain trouble for himself. Carbonic acid carrying ground water is practically always present and the cement pipe has yet to be built that will stand up against its action. Until a cement pipe can be made impervious to capillary percolation of water and long continued action of acid ground water it would seem the wise thing for cement people to turn their product to a better use.

Yours very truly,
Chas. Abbot Newhall,
Consulting Chemist, Seattle, Wash.

Modern Road Building Machinery

Descriptions of the Equipment That is Now Considered Necessary for the Construction and Maintenance of Highways—Hand Methods Have Little Use in Modern Road Building Operations

By E. H. BECK, C.E., A.M.E.I.C.

Continued from last issue

Stone Crushing Plant

The portable crushing plant shown in fig. 16 is typical of that used by townships, county councils and contractors. It consists of two portable units, one being the crusher and elevator, the other being the bin and screen. In this cut the plant is shown ready for operation. The weight of the crusher is taken off the wheels, being lowered or raised by means of screw jacks permanently fixed on the rear axle, thus always being in position when required.

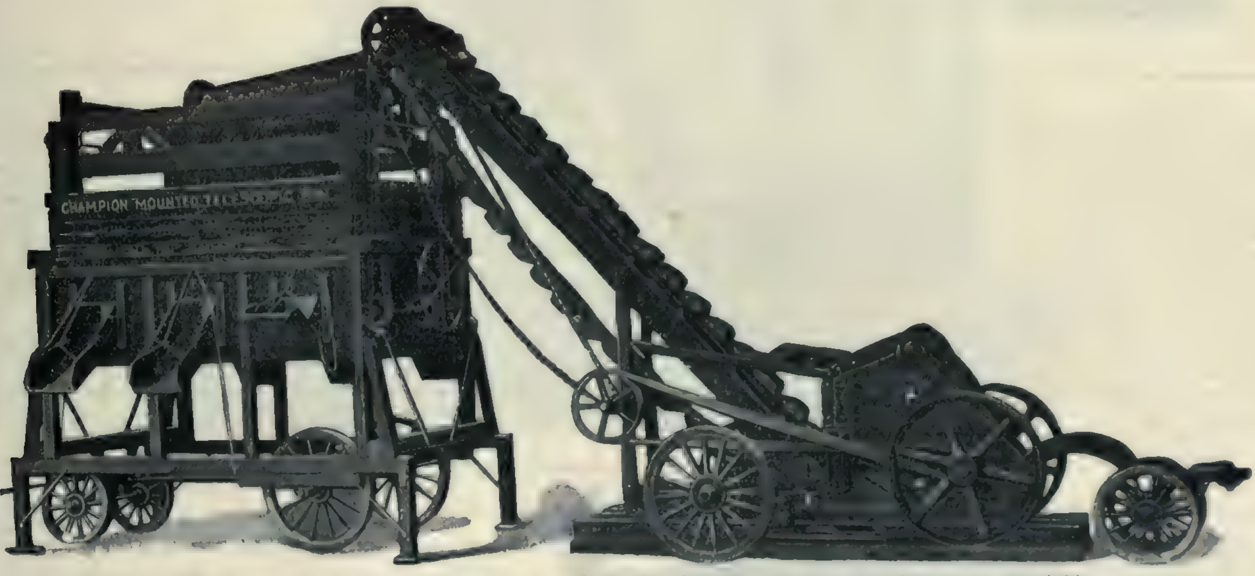


Fig. 16—A complete portable crushing outfit, mounted crusher, elevator, revolving screen and bin

Fig. 17 shows the same type of jaw crusher ready for transportation. The elevator is shown folded over the top of the crusher by means of a special folding device, which is operated by worm and gear seen at the rear. The worm is a great improvement on the usual gear and pinion used on the majority of folding devices, and does away with the likelihood of accident in lowering or lifting.

In fig. 17 is also shown a side loader for use in gravel pits; the material is brought to the loader, the foot of which may be sunk in a pit. The loader discharges on a screen, the large stones going into the crusher, and the small stones going through the screen directly into the elevator and up to the revolving screen on top of the bins.

Fig. 18 shows ready bin for transportation, screen being lowered into the bin, and the bin lowered on to the frame. Note that the wheels are inside of the framework, which enables the stone wagons to be brought close to the chutes when loading; also that the front wheels cut under, enabling the outfit to be turned in a small space. There are three chutes on each side, the bottom of the bin tapering in both directions, being partitioned off for three sizes of stone.

Crushers

Portable crushing outfits vary in size according to the output required. The following table gives a good

Table of sizes, products and weights.	No. 3	No. 4	No. 4½	No. 5
Size of receiving capacity of jaws inches	8x13	9x15	10x20	11x26
Product per hour in tons when closed to 2 inches	8 to 12	12 to 18	16 to 24	24 to 40
Weight, approximated	5500	8800	12500	20000
Weight of mounted crusher, with 18 ft. folding elevator	9300	12510	16500	
Speed-revolutions per minute	170	155	150	140
Driving pulleys, diameter and face, inches	38x8	48x9	50x10	60x9½
Horse power required	12	15	18	25
Horse power required when used with elevator and screen	15	20	25	35
Floor space required, ft.	4½x5½	5½x6½	7x7	8½x8½
Extreme height of machine	4ft. 7in.	5ft. 9in.	6ft. 1in.	6ft. 2in.
Size of elevator best suited—width of bucket	11in.	11in.	16in.	16in.
Diameter of screen best suited (in inches)	24	32	32	40

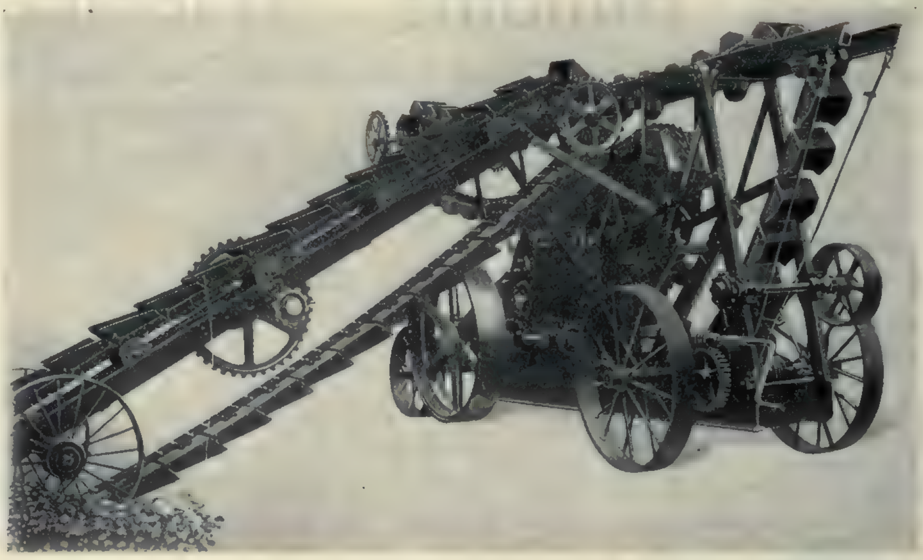


Fig. 17—This cut shows a side loader for use in gravel pits, attached to a rock crusher. Also the folding elevator attached and ready to be raised to working position.

idea of the sizes, products, weights, etc., of a typical built-up jaw crusher. In referring to the table, however, it should be pointed out that the R.P.M. given are considerably lower (about 50%) than the majority of crushers, owing to the fact that the movement of the jaw is transmitted from the driving shaft by means of a double cam, in place of an ordinary cam. This is shown clearly in fig. 19, the cam "F" with one revolution of the shaft giving two movements through the roller "E" to the tumbler "D", which in turn transmits the movements to the moving jaw through the toggle "G".

Gyratory crushers are mostly made in large sizes and are not, in my opinion, suitable for this class of work. Indeed, the large jaw crusher is gradually replacing the gyratory crusher.

The type of crusher shown in fig. 19 is made up to 24″ by 50″, weighting about 30 tons.

Features of the built-up type of crusher are the easy accessibility to any part, the easy adjustment for size of product, the fact that the heavy shock transmitted to the frame is taken care of by specially rolled steel plates instead of a casting, as is the case with the solid frame machine.

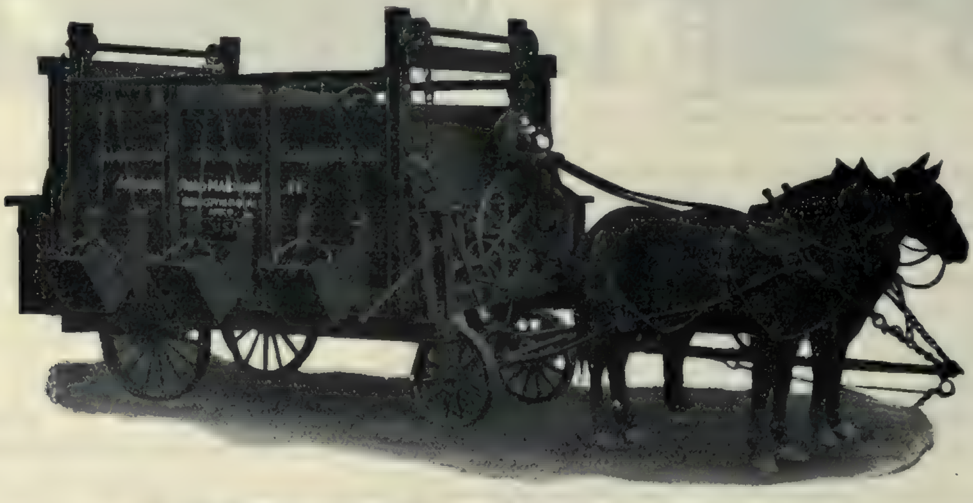


Fig. 18—Mounted telescopic bin, lowered in position, for moving on the road

Careful study of the parts of a crusher with the means of transmitting the power, and methods of distributing the shocks and stresses will soon show up the class of machine. For instance, a reference to the crushers given in this article might lead one, offhand, to state that the shocks and stresses go direct to the bolts holding the side plates of the machine, which would therefore be a great weakness. This is not so, however, as a reference to fig. 19 will prove. In this figure the reader will notice a groove in the side plate clearly discernible below the stationary "jaw" C. In the stationary jaw casting "C" is a projection on the other side, which fits into these grooves; the bolts simply hold the plates together and the shock is taken up directly by the plates, as the whole of the stresses brought into force by the crushing of the material is from end to end of the crusher, and not across the plates.

Stone crushing is necessarily heavy duty work, and in all such work maintenance is where money can easily be lost unless special attention is paid to that important detail. The reduction of speed made possible by the double cam already mentioned must undoubtedly be a source of saving in expense of maintenance. At the same time it is not possible to do away with the friction and the attendent wear and tear entirely. It is possible, however, to reduce the friction to a minimum by arranging and designing the wearing parts so that the greatest service may be obtained from them. By making part readily adjutable for wear in various other ways, maintenance costs can be kept down by obtaining the fullest use of the different parts without replacing until absolutely worn out.

The power driving the crushing outfit is usually obtained by use of a portable engine, tractor or roller, the drive being by belt to the crusher which transmits the power to the elevator and screen by means of gears and chain drives.

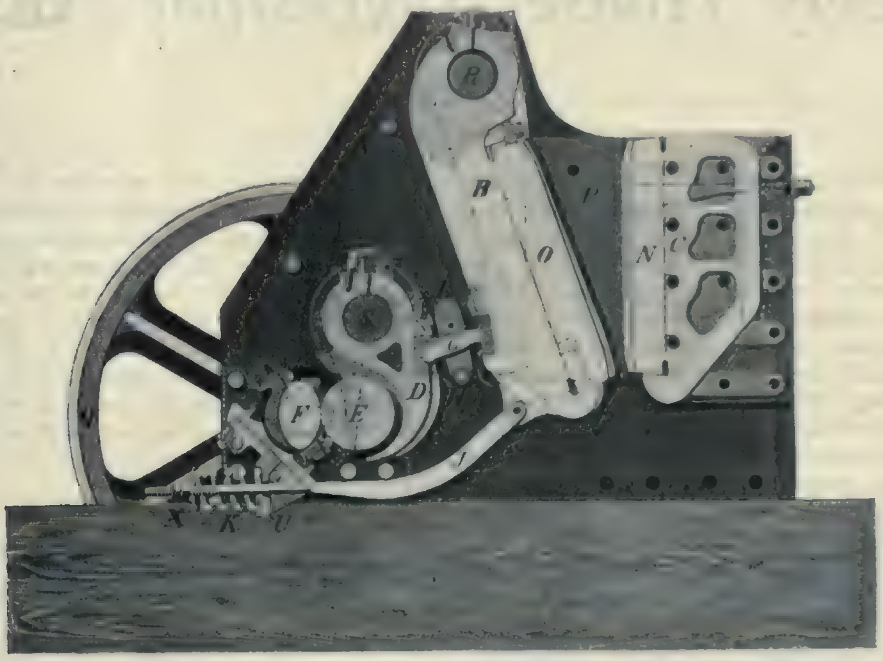


Fig. 19— Sectional view of crusher

Organization in the Construction Industry

By Col. Evan Shelby before the Associated General Contractors

This is the day of organization. Everything tends in that direction. There was a time when every large organization was under suspicion because of its power for evil. Today most countries, both by laws and executive action are encouraging such combinations because of their power for good. All people are directing their attention to the good that may be accomplished by organization. The Construction Industry has been the last important one to undertake to organize in a really effective manner.

Competition is necessary, but competition which expends useful energy with no commensurate good must be eliminated. In the construction industry there is too much competition in matters where such competition only amounts to duplication and waste for which the public must pay. There is ample room for the play of competition in the factors of service,—in skill, economics of production, integrity, and dependability.

In the matter of contracts alone will be found ample reason for the existence of an association of contractors. If the industry as a whole can be persuaded to adopt a form of contract which would be standard, immeasurable good will accrue to the country. A basic uniform contract, which shall gradually receive judicial interpretation which will be recognized in all courts will eliminate untold waste in the countless litigations which grow out of mere variety form of construction contracts.

Progress in legislation dealing with the construction industry requires combined effort to accomplish. Joint effort not only irons out the differences in the industry itself, but produces the desired effect upon those whom we call to legislate for us. Construction contractors are responsible for the expenditure of such enormous sums of money—nearly four billion dollars a year—that they should be organized in a way to deal most beneficially and effectively with the collective groups from whom they must buy the labor and the materials for their work.

Highest Class of Skilled Service

Public opinion is one of the largest assets in any industry. To direct and properly influence public opinion is particularly the function of organized endeavor in such industry. It is not half as important that contractors as such should make large profits for themselves as it is that the great construction industry should be right—that is, that it should be conducted on the highest principles of fair dealing and efficiency, and that the world should be made to know that construction contractors are not just gamblers on how much a piece of construction work will cost, but are producers—are industrial workers who are rendering to the public the highest class of skilled professional and managerial service.

Trade Incorporations

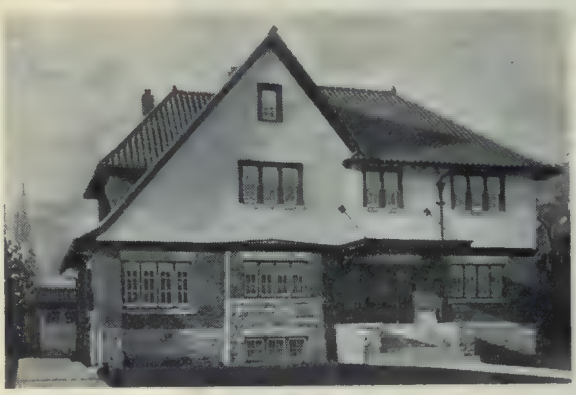
The Ottawa Sectional Home Building Company, Ltd., with head office at 11 Irving Ave., Ottawa, capital $40,000, to carry on the business of building contractors.

Brennan Paving Company, Limited, with head office at Hamilton, capital $100,000, to carry on the business of general and paving contractors.

The Contract Record's

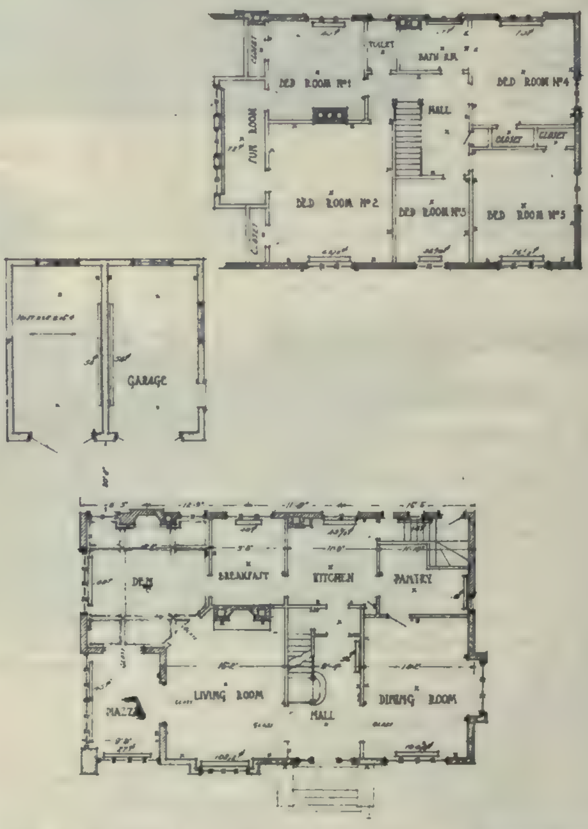
Weekly House Suggestion No. 15

The attractive brick and stucco residence illustrated was recently completed on Wells Hill Road, Toronto, for Mr. H. G. Stubbs. Milton pressed brick, medium grade stucco and piebald stone for trim were used in the exterior construction, with red Spanish tile roofing. The rooms on the ground floor are divided into two sections by the centre hall, the dining room, pantry, kitchen and breakfast room being to the right and the living room, den and conservatory to the left. The hall and den are panelled to a height of 4 ft. 6 in. with quarter-cut oak panelling, and the dining room to a height of 6 ft. 6 in. with walnut panelling. The kitchen and pantry are finished in white enamel and tile to a height of 5 ft. 6 in. with 3 x 6 tile. The breakfast room is finished in French gray enamel and panelled to a height of 6 ft., with blue satin finish on the panelling. The conservatory is also finished in French gray and floored with red quarry tile. The flooring in the balance of the house, with the exception of bath room and toilet, is of oak, upstairs and down.



The upstairs trim is pine, finished in white enamel and mahogany, all doors being mahogany. The walls in the bathroom and separate toilet are of 3 x 6 tile to a height of 5 ft. 6 in., while the floors are of 1 in. hexagon tile.

The basement plan provides for a large billiard room in addition to the accommodation for heating plant, coal storage, etc. A Spencer hot water heater provides the heat for the house, and was installed by W. H. Miles & Co. As seen in the accompanying illustration, there is a large two-car garage situated at the rear of the house. Messrs. A. Weller & Co., executed the wood work, Messrs. John Boyce & Sons, the plaster work, and the painting was done by London Bros. Mr. J. A. Thatcher, 24 King St. W., Toronto, was the architect.



Plans of the ground and first floors of the residence described herein

Mainly Constructional

East and West—From Coast to Coast

The city of London, Ont., will make application to the legislature for an act to authorize the council to pass a by-law, without obtaining the assent of the electors, for the issue of $141,000 debentures, for the erection of a dam in the River Thames.

The government housing funds have been entirely exhausted at Winnipeg and nothing further can be done for applicants at the present time. The housing bill is under consideration in the provincial legislature.

The provincial highways department of Ontario, has received about 1,100 tenders for road work during the coming year. These involve about 350 miles of grading, about 40 miles of paving, and many culverts.

A report from Ottawa quotes Mr. J. A. P. Hayden, president of the Allied Trades and Labor Council, as saying "There will be no strike in the building trades this year, and I expect that all of the trades will have their 1922-23 agreements signed up and their wages settled before the building season gets under way."

Mr. Charles Evan Fowler, chief engineer of the Detroit-Windsor bridge, addressed the Civil Engineers' Club of the University of Toronto recently on bridges, tracing the evolution of the bridge from the early types constructed in ancient Persia and Egypt to the huge structures of the present day. Mr. Fowler illustrated his remarks with a number of interesting lantern slides dealing with the artistic treatment of bridges, and particularly the proposed Detroit-Windsor bridge.

The Carter, Halls, Aldinger Company, of Winnipeg, has secured the contract for a $300,000 addition to the Great West Life Assurance Company's Building in that City. Four storeys will be added to the present four-storey structure, work to commence immediately and be finished by October 1.

The action of the Dominion Government, in calling for tenders for concrete memorials to commemorate historic events of Canada, resulted in a strong protest from the Memorial Craftsmen of Canada. A deputation representing many of the large marble and granite firms, appeared before the Minister of the Interior, Hon. Mr. C. Stewart, and asked that the government reconsider their decision, contending that cement was not a suitable material for this purpose and pointing out the advantages of marble and granite from the standpoint of beauty, which is the big consideration in a memorial of any kind.

The Provincial Paper Mills, Limited, at Port Arthur, Ont., is considering the use of concrete in the construction of a new paper mill and extensions to the present plant, instead of brick, owing to the unsettled condition in bricklaying labor circles, which means delay in getting started on these works. Bricklayers in Port Arthur have refused an offer of 90 cents an hour. The provincial Paper Mills' program of construction would mean about seven months steady work for bricklayers.

Mr. H. C. Carpenter, Deputy Minister of Highways, of Saskatchewan, at the recent annual convention of the Associated Boards of Trade of the province, held at Prince Albert, advocated the need for a provincial good roads association in the province.

Everything is in readiness at Windsor, Ont., for an early start on the city's road construction porgram. A suitable site for the city's asphalt plant has been secured in the factory district between Marantette and Elsmere Avenues, and wooden structures have been erected to house the various machines. Ouellette Avenue, Wyandotte Street, Mercer Street, Montmorency Street and Howard Avenue will be surfaced with sheet asphalt during the coming season. The road maintenance department, under the supervision of Mr. C. F. Fitzgerald, also anticipates a busy season this year.

It is announced that Toronto and New York capital has commenced on the development of the Schreiber gold mine area in Northern Ontario. Mr. Harry Harkness, of Fort William, Ont., has been appointed purchasing agent for the syndicate which is in the market for boilers, hoists, compressors, steel rails, piping, teams, harness, shovels, picks, etc. It is stated this development involves $2,500,000.

The Restigouche and Bay Chaleur Hospital, at Campbellton, N. B., was opened recently. The new hospital is beautifully situated in a large private park on the summit of a hill overlooking Campbellton. The building is 95 ft. x 63 ft., four storeys, the first of reinforced concrete and the three upper of red brick faced with rustic citadel brick, thoroughly fireproof throughout, and was erected at a cost of $125,000.

Personal

Mr. William L. Symons, Architect, is resuming his private practice after five years in the Dominion Government Service, first as officer in charge of works for the Military Hospital Commission and latterly as architect in charge of Military Hospitals, Public Works Department, Ottawa. Mr. Symons has opened offices at 119 Bay Street, Toronto.

Messrs. O. A. Cole, Ltd., Dominion agents for Truscon Laboratories, have located at 311 King St. E., Toronto, Ont., where a complete stock will be carried They desire to open negotiations with firms throughout the Dominion to act as local distributors in their respective locality.

Mr. L. W. Wynne-Roberts is opening a branch of the Toronto consulting engineering firm of Frank Barber & Associates, at Chatham, Ont., to look after the Western Ontario business of this firm. Mr. Wynne-Roberts has been succeeded as resident engineer for the Chatham district of the Provincial Highways Department by Mr. John Sears.

Mr. Leo. Stamford has become associated with his father, Mr. J. Hunt Stamford, architect, 67 Yonge St. Arcade, Toronto, the firm to be known as J. Hunt Stamford & Son.

Mr. J. Woods, road foreman of the city of Kitchener, Ont., has resigned from this position, his resignation to take effect at the end of this month. Mr. Woods has occupied this position since May 22, 1921.

Mr. C. H. R. Fuller, city engineer of Chatham, Ont., has been recommended for the position of city manager, under the new scheme of municipal government approved by the citizens at the last elections. The city council will deal with this recommendation at a special meeting.

Mr. A. B. Silcox, head of the engineering branch of the Toronto Municipal Research Bureau, of Toronto, has been appointed director of the Citizen's Municipal Research League of Calgary. Mr. Silcox graduated from the School of Practical Science, Toronto University, in 1916.

Mr. Frank Ansell who for the past 20 years has been connected with and represented the Metallic Roofing Co., Limited, has accepted a similar position with McDermid Bros., Ltd., jobbers of roofers and tinsmith supplies. Mr. Ansell, who is well and favorably known among the trade, will give special attention to the sheet metal department of the business. The new company is expanding rapidly and the addition of Mr. Ansell, who is taking a financial interest, should assure it of even greater success for the future.

CONSTRUCTIONAL ACTIVITY

Period of March 22 to March 28, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Cloverdale, B.C.
Plans are being prepared for hard-surfacing last of 6 mile stretch of the Pacific Highway, extending from Cloverdale to the international boundary at Blaine, U. S. A. Patrick Philip, Engr., Victoria and Vancouver.

Cornwall, Ont.
J. G. Harkness, Town Clerk, has plans and will receive tenders until April 8th for construction of pavement on Pitt St. Marked cheque for $1,000 required.

Cranbrook, B.C.
Construction of waterworks extensions costing $35,000 is contemplated by City. W. H. Eassie, City Engr.

Dunnville, Ont.
Town Council plan construction of cement sidewalks at cost of $20,000 on several streets. Jno. Clark, clerk.

Essex, Ont.
Plans will be prepared for tile drainage work for Colchester North Twp. Council. A. C. Atkinson, clerk, Essex. C. B. Allison, Engr., South Woodslee, Ont.

Galt, Ont.
City will construct sewer and storm drain at cost of $7,713 on State St. from Concession St. to Bruce St., work by day labor. J. D. Black, Engr.

City will construct by day labor sewer and drain at cost of $5,956 on Maple St. from State to Harris Sts. J. D. Clark, Engr.

Hamilton, Ont.
City Council plan construction of sewage disposal system in East End. E. R. Gray, Engr.

Tenders will be called shortly for construction of sewer costing $20,000 on Northcote St., and sewers on Gertrude St. and Charlton Ave. E. R. Gray, Engr.

Harrow, Ont.
Good Roads Committee of Colchester South Twp. Council plan highway improvements and construction of pavements to cost $70,000. J. H. Madill, Twp. Clerk, Harrow, Ont.

Nelson, B.C.
Prov. Govt., Dept. Pub. Works, contemplate roadwork on Ymir Highway. P. Philip, Engr., Parliament Bldgs., Victoria.

Newmarket, Ont.
Town Council plan construction of permanent pavement on Prospect Ave. from Pearson St. to Huron St., Queen St. from Prospect Ave. to G.T.R. bridge, Park Ave. and Trinity St. from Lawrence St. to Main St., Millard Ave., about 300 yards. H. Anderson, clerk.

Orillia, Ont.
C. E. Grant, Town Clerk, will receive tenders until April 3rd for construction of pavements on Colborne, Neywash and Laclie Sts. James, Proctor & Redfern, Ltd., Engrs., 36 Toronto St., Toronto.

Ottawa, Ont.
Tenders will be called shortly for construction of sewer costing $12,000 for City. A. F. Macallum, Commr. of Works.

Thedford, Ont.
Tenders will be called shortly for drainage work to cost $55,000 for Bosanquet Twp. Council. Geo. Sutherland, secy., Thedford. Geo. A. McCubbin, Engr., 135 King St., Chatham, Ont.

Toronto, Ont.
James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., have plans and will receive tenders until April 1st for approximately 14,000 cu. yds. of earth excavation for Markham and Whitchurch Twp. Councils.

F. Barber, Engr., 40 Jarvis St., has plans and will receive tenders until April 3rd for construction of sidewalks and pavements on several streets for York Twp. Council.

CONTRACTS AWARDED

Ottawa, Ont.
City Council awarded contract for cast iron pipe to National Iron & Steel Ltd., 211 McGill St., Montreal. Contract for pipe fittings is placed with Lawson & Sons, Wellington St., Ottawa.

Penticton, B.C.
General contract for irrigation system costing $6,600 for City is awarded to Pacific Pipe & Flume Works, Ltd., Penticton. R. A. Barton, Engr., Kelowna, B.C.

Toronto, Ont.
Council awarded following contracts for sewers costing $43,100: Larchmount Ave. at $5,475, Rushbrooke Ave. $5,631, J. H. McKnight Construction Co., 88 St. David St.; Berkshire Ave., $5,551, Ruscica Bros., 256 Ontario St.; Marigold Ave. and 2 sections of Eastern Ave., $26,449, Commr. of Works, by day labor.

Railroads, Bridges and Wharves

Anyox, B.C.
Granby Smelting & Mining Co., Anyox, are building, by day labor, railway at cost of $50,000.

Bindloss, Alta.
Steel bridge is being constructed over Red River, by day labor, by Prov. Govt.

Hamilton, Ont.
Dominion Power & Transmission Co. and Hamilton Street Rly., Terminal Station, contemplate repairing tracks on Locke, Wentworth, Margaret and King W. Sts.

Mount Forest, Ont.
Erection of bridge is contemplated by Twp. Council. Chrm., Warden Milloy, Erin, Ont.

St. Edouard de St. Georges, Que.
Arthur Belouin, secy. Town Council, has plans and will receive tenders, no closing date set, for construction of concrete bridge. Plans also with I. E. Vallee, Engr., Pub. Works Dept., Prov. Govt., Que.

Victoria, B.C.
Mr. Bradley, City Clerk, Victoria, will receive tenders until April 17th for bascule span and removal of old Johnson St. bridge. Plans with City Engr., The Jamieson Engineering Co., 103 London Bldg., Vancouver.

Waterways, Alta.
Construction of roundhouse is contemplated by Alberta & Great Waterways Rly.

CONTRACTS AWARDED

Thurso, Que.
A. Lyons, Thurso, has general contract for construction of combined bridge and dam over White River for J. & G. Black Ltd., Thurso.

Vancouver, B.C.
General contract for foundation piers for bridge costing $200,000 across Coquitlam River for C.P. Rly. is awarded to W. D. Grant, 739 Granville St., Vancouver. Steel contract is placed with Canadian Bridge Co., Ltd., Walkerville, Ont. H. Rindal, Engr. Pacific Division, Vancouver.

Public Buildings, Churches and Schools

Agassiz, B.C.
Agassiz School Bd. plan erection of high school and addition to public school at cost of $20,000.

Airdrie, Alta.
Glen Rock School District plan erection of school. H. A. English, architect, Airdrie.

Erection of addition to school is contemplated by Airdrie S.D. No. 918. H. A. English, architect, Airdrie.

Big Valley, Alta.
Dunbarney School District No. 4043 plan erection of school according to Dept. of Education plan A-14. H. J. Stewart, secy.

Bronte, Ont.
Erection of consolidated school is contemplated by S.S. Nos. 13, 15 and 18. O. Flummerfelt, secy., Soverign St., Bronte.

Esterhazy, Sask.
Erection of police headquarters is contemplated by Prov. Govt., Dept. Pub. Works, Regina.

Fort Frances, Ont.
R. E. Mason, architect, Fort William, Ont., has plans and will receive tenders until April 7th for alterations and addition to school for Fort Frances School Bd. Plans also with MacLean Building Reports Ltd., 348 Main St., Winnipeg.

Galt, Ont.
Public School Bd. contemplate erect-

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An Analysis of Building Costs

The National Bank of Commerce in New York, which in its Commerce Monthly periodically makes authoritative and well studied comments on current business topics, refers at some length in the April issue of its organ to the problem of high building costs. This bank's analysis of the situation leads it to conclude that high labor costs are directly and indirectly responsible for high building costs. The reasoning by which this conclusion is attained is abstracted in the following paragraphs:

Building costs are out of all proportion to costs in other lines. The main factors entering into building are materials, transportation and labor. Prices of materials at point of production have been well liquidated, although an upward tendency would quickly depress the present building movement. There should be no illusions as to what the traffic will bear.

High freight rates due to labor conditions and high wages due to labor are the controlling factors in building costs. They maintain construction prices at levels that interfere with the full and well-rounded development of building operations. They also serve to inject an element of fixed inflation into this, the greatest construction movement in the nation's history.

The lack of well-balanced development is made manifest by an analysis of contracts let and permits issued to date. Residence construction leads. Public buildings, roads, bridges, and other types of building are next in importance, stimulated somewhat by desire to relieve unemployment. Business and industrial construction, which must be done on a basis of cost that will permit a present and continuing return on the investment, has not expanded correspondingly.

Despite the handicap of high costs, home building activity is being maintained for the present because the housing necessity compels it, even on the basis of uneconomical investments. Public building and construction are also being done on a high cost basis which will be reflected in high tax rates for years to come. Public building, like residence building, cannot continue indefinitely under these conditions.

Labor itself is the chief sufferer in the situation. Resistance by important classes of labor to wage declines in a period of declining prices disorganizes the entire productive organization of the country and contributes to unemployment in other lines. The maintenance of building operations on high wage levels delays general wage readjustment. It means exorbitant rents and prohibitive costs for homes for workmen. It is a general deterrent to a return to normal industrial, commercial and financial activity.

On the whole labor costs in the building field are not greatly reduced from their maximum. Transportation is a very large part of the laid-down cost of building materials and the adjustment of railroad rates is deferred by the refusal of railway labor to recognize that the period of war wages is over. In other words, high building costs are being maintained directly and indirectly by labor costs. It is there that the fundamental correction must be made.

Montreal Harbor Development During the Past Year

Much information of interest to those having to do with the port of Montreal is contained in the report of the Montreal Harbor Commissioners for the year 1921, which has just been issued under the signatures of Messrs. W. G. Ross, Farquhar Robertson and Brig.-Gen. A. E. Labelle, commissioners of the port from 1913 to 1921, inclusive.

The year 1921 was a notable one in the history of the port, which fact is attested by the many records broken during the period. These achievements are enumerated by the commissioners as follows: The greatest number of ships in port on any one day; the greatest number of ocean arrivals in any one year; the greatest tonnage of ships in any year; the advent of the new C. P. R. 2,000 bushel cars for grain, which were in operation throughout the year in connection with the extensive grain movement between Georgian Bay ports and Montreal; the greatest grain movement through the port of Montreal, doubling any former record in the history of the port; the highest annual interest charges to be paid by the Harbor Commissioners, and which the commissioners are pleased to state are being fully paid as they become due, and the redemption of public debentures to the amount of $407,000.

Port Improvements

The commissioners state that the year 1921 was a successful one as regards port improvements made during the year, three important items of the programme of improvements having been practically completed, namely: Victoria Pier, including the fine new transit sheds, 17, 18 and 19, and the Sailors' Memorial Tower, located on the end of the pier; the new cold storage warehouse and power house, and the electrification of the harbor railway terminals.

No national public expenditure at any time or

No. 82

Canada's Engineers—A. D. Creer

Born in York, Eng., Mr. A. D. Creer received his school training in St. Peters, York, the oldest public school in England. His college course was taken at Yorkshire College, Leeds. Leaving college Mr. Creer became articled to his father, Mr. Alfred Creer, city engineer of York, and in that work he spent his junior engineering years. Later he went to London and joined the staff of James Mansergh & Sons, remaining with that eminent consulting authority for fourteen years. During that time Mr. Creer was engaged on the construction plans of many important public works connected with water supply and sewage disposal for which Mr. James Mansergh has been retained as consulting engineer. Among the enterprises with which he was thus connected were the Birmingham water supply, Plymouth sewerage system, Exmouth sewerage system, Coventry sewerage system, Colombo, Ceylon, sewerage system, Rochdale waterworks, Tynemouth waterworks and other similar undertakings.

Coming to Canada in 1911, Mr. Creer became associated with the engineering staff of the city of Toronto, spending a year on the drainage works being constructed by that city. In 1912 he came to Vancouver with Mr. R. S. Lea, consulting engineer of Montreal, who had been retained by the joint committee of Vancouver city and adjoining municipalities to report on the proposed comprehensive sysetm of sewer mains later adopted and initiated under the Vancouver and District Joint Sewerage Board. Mr. Lea invited Mr. Creer to join him in the preliminary investigations upon which the expert's now historical report was founded. On the formation of the Sewerage Commission, after the Provincial Government had acceded to the request of Vancouver and the municipalities and passed necessary legislation founding the District, Mr. Creer became chief engineer for the board, a position he held until last year.

All the main trunk sewers so far constructed under the Sewerage Board authority were designed and the work carried on under the direct professional supervision of Mr. Creer. In the ten years during which he held office, he directed the expenditure of capital in sewer construction to a total of three million dollars. In carrying out the work, the general policy and scheme outlined in Mr. R. S. Lea's report was adhered to in the main, necessary detail changes being made to suit conditions as they developed.

A. D. Creer

Mr. Creer is a member of the Institution of Civil Engineers, London, England, also a member of the Engineering Institute of Canada. He is now in private practice as a consulting engineer, with offices in the Metropolitan Building, Vancouver.

place has proven of such exceptional advantage, says the report, as the development of the port of Montreal, and the public is assured that the successful progress of Canada and the development of the port of Montreal will go hand in hand in the future, as in the past. The commissioners call the attention of the Minister of Marine and Fisheries, and of the Government and people of Canada, to the fact that although the scheme of harbor development adopted in 1910 was designed to be ample for twenty-five years, they have to report that at the end of eleven years, with the principal items of development completed, the accommodation provided by the scheme of 1910 is inadequate for the business offering. They also state that although it was not expected that during the intervening years the business of the port would be able to pay during construction the added interest arising from the cost of the scheme of improvements, that interest has, nevertheless, been regularly paid year by year.

"The present business of the port and the present revenues of the port alike point to an urgent, necessary and financially justifiable new scheme of additional harbor development in the port of Montreal," state the commissioners.

The report states that the proposal for a new bridge to connect the McGill street approach to the harbor with the Victoria Bridge basin, St. Helen's Island and the South Shore, is again a live issue, both in connection with the develpment of the harbor, the development of the South Shore municipalities and the prosperity of the city of Montreal. After referring to the excellent tramway and vehicular connections the brdge would afford by virtue of ts position, the report states that it would permit the thorough utilization of St. Helen's Island as a city park. "The whole of the lower portion of the island could be developed into a splendid bathing beach; with tramway lines surrounding the island and a boulevard for motor cars; this, in summer, would be a most healthful adjunct to this great city."

The new cold storage plant, which comes into operation on April 15, is described in detail, as are the new transit sheds on Victoria Pier, and the operations of the harbor railway terminals and the progress of their electrification.

Highest Quality Building Marbles Found in Central Ontario

Unlimited Deposits of the Finest Ornamental Marbles on the Continent Await Development—Conditions for Quarrying and Marketing the Stone are Exceptionally Favorable

By C. PRICE-GREEN
Commissioner, Industrial and Resources Department, Canadian National Railways

In one of the large buildings recently constructed in Toronto, Ont., there can be seen some marble of a blue and white variety imported from Alaska for the special purpose of decorating its entrance. It makes the place look about as cheerful as an undertaker's establishment, although it must have cost those who installed it fully twenty dollars a cubic foot. The importation of this marble, to my mind, is all the more extroardinary, when it is known to the trade that in Central Ontario, a short distance from Toronto, marbles, superior in quality and appearance, are available.

I am told, and I believe it to be true, that last spring a representative of a marble company in the United States, during the course of a few weeks, sold over one hundred and twenty-five thousand dollars worth of marble in Eastern Canada for monumental purposes. When one considers our adverse balance in trade with the United States and our tariff relations, it is a matter of wonderment that our people import from our neighbours to the south many of the things they do, that could be produced quite readily in this country.

Here at least is one case where this condition should be remedied. In the Bronson area in the province of Ontario, as I have already mentioned, there is undoubtedly, the finest body of marble on the continent of America, proved to a great extent by a developing company, but needing capital for operation. Here the finest grained and highest quality of marbles are lying more or less dormant in unlimited quantities and in innumerable varieties, including all the standard marbles used for ornamental and other purposes in the building trade.

Almost Inexhaustible Supplies

The depth of these deposits has been estimated by the geological survey as something like 55,000 feet—only a fraction of this depth would be workable in practice. Taking, however, 200 feet of it, actually proved and tested as a result of core drilling it gives us over one hundred million cubic feet in three or four of the larger exposures alone—a practically inexhaustible deposit.

In the report issued by the Dominion Government on "Ornamental Building Stone," reference is made to this area, and the attention of Canadian architects directed to the possibilities of its product for interior and exterior building purposes. The report sets forth the strength, non-straining qualities and other desirable properties of these dolomitic marbles, and their general superiority to the varieties generally imported into this country.

At the time of the world's geological congress, a number of the members visited this area, and it was regarded as one of the unique features of their trip, the deposits representing one of the largest sources of raw material of its kind on the American continent. At that time one of the members of this party was speaking of the magnificent appearance buildings would have if constructed of the white dolomite, when a newspaper correspondent asked if these marbles would stand the weather of the Canadian climate. Looking at an exposure at his feet the geological said "Young man, do you see those grooves?" Being answered in the affirmative, he said, "They are the answer to your question, they were made by the ice in the glacial period."

Very Favorable Conditions for Quarrying

Physical conditions for development are all particularly favorable. The Central Ontario branch of the Canadian National Railway runs through the property in the immediate vicinity of the quarries, which are above the general elevation of the line, thus enabling tramming to the mill and railway more or less down grade. Another important economic feature is that for domestic distribution and for export to the United States or Great Britain the quarries occupy a very central position.

Adjacent to these deposits are water powers that have been leased by the Canadian Marble Quarries, Ltd., the developing company, which when they have the capital available to harness them should place the cost of quarring below that of other similar industries, as the quarrying and milling machinery can be operated by electricity at a much lower cost than by coal, and it is much more adaptable to winter operations.

A phenomenon presented by these deposits that is of particular interest is that to a large extent the strata lie in a perpendicular position. Thus it is not necessary when taking out any given variety to first expose other strata, as in most quarries where the marble lies in a horizontal position. Moreover, this cuts down the cost of prospecting and opening up the bodies.

It is desirable to emphasize the importance of these stones, not only for interior decoration, but for the exterior of buildings. The use of dolomitic marbles for exterior work is capable of a great development. As a large contractor said to me recently, "It is only a few years ago that the buildings in the United States erected of marble could be counted on the fingers of one hand, while to-day it is a common practice." It is not intended that marble should compete with the building stones in common use in the matter of price, but quarried in large quantities the price will be surprisingly low, and where quality is the desideratum, the difference in cost of raw material would not be an obstacle. It may not be out of place to remark that for exterior finish, marble is infinitely superior to the imported tile that has come into use in recent years.

The lack of knowledge of our building stones is rather lamentable. Recently I heard a talk on the subject by an admitted authority who had a wonderful fund of information on the subject of imported sandstones and limestones, but little or nothing as to the applicability of these dolomitic marbles. On the other hand, I found that one of our largest contractors with an experience in handling stone over a long period of years, and whose attention had recently been directed to one of the varieties, pronounced it the acme of quality and suitability for exterior purposes.

Perhaps one of the merits of this proposed development lies in the fact that not only can these deposits supply unlimited quantities of what may be termed standard marbles at a minimum cost, but in addition, a large number of monotones and distinctive varieties with a wonderful range of color that will, I am assured, find a wide market in the United States as they are not to be found elsewhere on the continent.

Progress on the Ballantyne Pier in Vancouver Harbor

A Five Million Dollar Project Comprising a 750,000 Cu. Yd. Gravel Fill Surmounted by a Reinforced Concrete Structure on Cylindrical Piers—Piers are Pre-cast Sections Sunk by Open Dredging and Jetting Methods

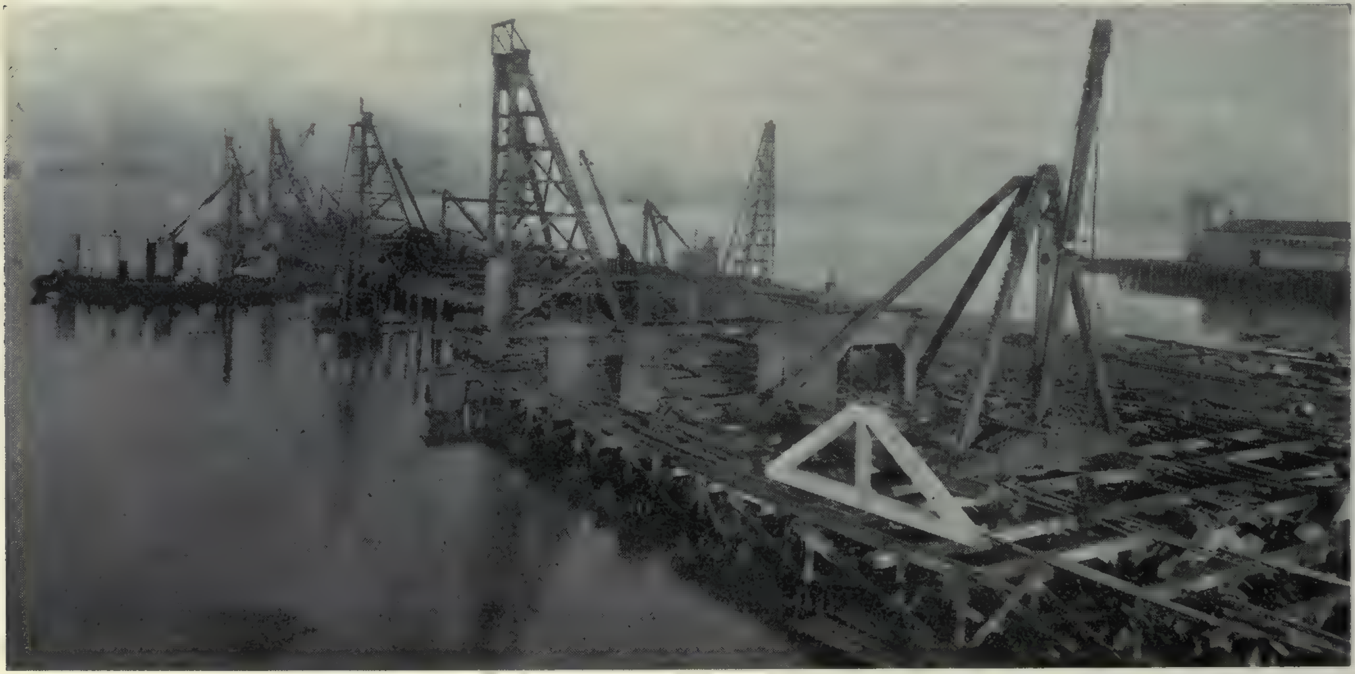
By the Contract Record's Coast correspondent

One of the largest undertakings of its kind on the Pacific Coast is the Ballantyne pier which is being constructed by the Northern Construction Company and J. W. Stewart, contractors, for the Vancouver Harbour Commission. Costing in the neighborhood of $5,000,000.00 it will on completion, which will not be before the summer of 1923, be a notable addition to the cargo handling facilities of the port of Vancouver, and furnish adequate deep sea berths in connection with the terminals of the Canadian National lines which are also in an advanced stage of development.

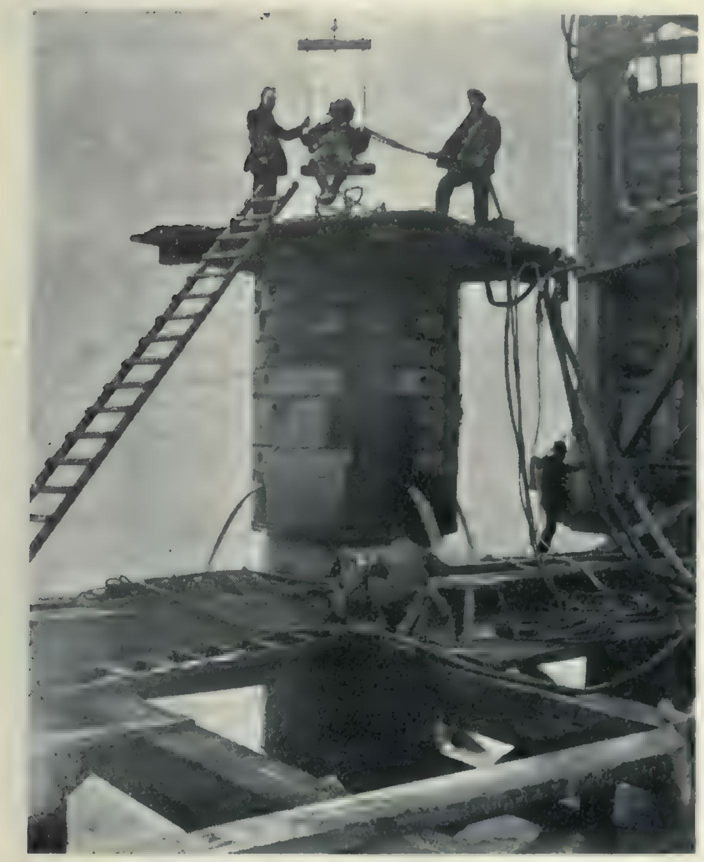
The pier has been designed by Mr. A. D. Swan, consulting engineer of Montreal, and is under his direct charge during the construction period. He is represented on the works by Mr. E. H. James, A.M. E.I.C., resident engineer.

The general design of the pier, which is to be 1200 feet long by a total width of 340 feet, is that of a gravel fill with slopes at a safe angle below the natural angle of repose, surmounted by a reinforced concrete structure on cylindrical piers, carrying the sheds and tracks and constituting the ship berths. The central portion of the pier, which is at the level of the top of the earth fill itself, carries a paved roadway which will afford access to the four two-storey reinforced concrete goods sheds which will range along the length of the pier, two on each side of the roadway.

The central fill, together with a smaller alongshore fill required for approaches, totalled 750,000 cubic yards in volume, and up to about low water



General view of construction, Ballantyne pier, Vancouver, B.C., showing pre-cast units of cylinders and of concrete trusses being placed in position



Jetting down concrete cylinder to bed rock. Diver just up from examination of interior of cylinder

mark was deposited by dumping from scows the material obtained from dredging operations carried on simultaneously in the first Narrows, the entrance to Vancouver Harbour. A dipper dredge with a six cubic yard bucket was used for this work. After the fill reached low water mark, the material was necessarily handled mechanically, and a clamshell worked from a scow was employed to finish the work to grade. The alongshore portion of the fill already mentioned was largely deposited by suction dredge.

Upper: Scow load of pre-cast sections of cylinders for Ballantyne pier, Vancouver, B.C.
Lower: Storage yard for pre-cast trusses for Ballantyne pier

The substructure of the reinforced concrete deck consists, as has been noted, of cylindrical piers. These piers, which are 7 feet in diameter outside and 5½ feet inside, are made in precast sections and sunk to depth by open dredging, a small orange-peel bucket being used for the purpose. Some of the cylinders at the outer end of the pier have been sunk over a hundred feet before solid rock formation was reached, and it has been necessary in some cases to resort to jetting methods for forcing the cylinders down to their final depth. An interesting incident in connection with this is illustrated in one of the accompanying photographs, which shows the diver just returned to surface after an examination of the interior of one of the cylinders. In this case while the shaft was being sunk by the jet, a column of water suddenly shot up to a height of eight feet from the surface of the water, and it was thought that possibly a submerged watermain had been struck and broken. The diver's examination, however, showed that nothing worse had occured than a blow through of the water being used for jetting, following what was evidently a fissure in the clay stratum through which the shoe of the cylinder was passing at the time.

In the cases of the inner rows of supports, which are located near the top of the fill, it has been judged sufficient in some instances to use groups of piles for supports, in place of forcing the cylinders themselves down to bed rock as was essential with the outer rows. A deep truss of reinforced concrete, also precast in sections, connects the head of all cylinders and forms the main framing for the deck itself. Some of these are already in place, work on them having been started in February. The illustrations herewith show these trusses as well as the cylinders in various stages of completion.

Construction Uses of Lime

The important construction uses of lime are the making of mortar, plaster, concrete, stucco, sand-lime brick, and cold paints.

(a) Mortar.—Brick, tile, and stone mortar both gauged and straight are made with lime wherein it functions as a bonding agent, plasticizing agent, and toughening agent.

(b) Plaster.—The scratch, brown, and finish coats of gauged and straight lime plaster involve the use of lime where it serves as a bonding agent, whitening agent, plasticizing agent, and produces a quality of plaster that is sound-deadening.

(c) Concrete.—Cement and asphaltic concrete are made with the use of lime. In cement concrete, lime functions for the agencies of water-tightening, whitening, strengthening, plasticizing, hydrating, and physical stabilization. In asphaltic concrete it serves as a cooling, hardening, and filling agent.

(d) Stucco.—Sorel or oxychloride cement and straight lime and gauged stucco involve the use of lime wherein it functions chemically as a reagent and physically as a bonding, plasticizing, toughening, and water-tightening agent.

(e) Sand-Lime Brick.—In sand-lime brick manufacture, lime functions as a physical and chemical bonding agent through union with the sand, as a whitening and strengthening agent, and as an agency for hydration and neutralization.

Mission School in the Far North Built by Interesting Methods

Five Thousand Selected Logs Sawn into Rafters, Flooring, Joists, Dimension Timber and Lath by Portable Saw Mill Taken to the Site Over the Ice—Building is Completely Equipped With Electric Light, Sewage System and Pressure Water Supply

Lac la Ronge is a little mission in northern Saskatchewan, 150 miles north of the nearest railway centre, yet it is modern in many ways. It has electric light, a water system, a sewage system and well constructed buildings. One of their chief buildings is shown in the photograph. It is a mission school and the story of its erection is full of interest.

The dimensions of this building are, roughly, 300 ft. x 100 ft., three storeys high. It has accommodation for 80 boarders and class-room accommodation for 125 students. The school is in charge of the Rev. Mr. Hives, who explains that during the winter months a small portable sawmill was taken in over the ice. With the opening up of spring, this mill began operations. Five thousand logs, carefully selected, were brought to the mill and sawn into the sizes necessary for construction. This little mill turned out the rafters, flooring, joists, sills and all dimension timber, as well as the common boards, flooring, sidings and moulding. Some 70,000 lath were also cut by the mill.

Native lumber and home-burned lime were used to build this 300 x 100 ft. school

Lime for plastering and foundation work was obtained eight miles distant from the building site, where a deposit of high grade limestone was discovered, a kiln set up and the lime burnt and brought to the building location in first class condition. The finest quality of sand was also available in the immediate vicinity. In fact, Mr. Hives states, everything was produced on the ground, with the exception of the shingles and the necessary metal parts.

The lighting plant is a Delco system, operated by gasoline engine. All the buildings around the mission, as well as the school and the church, are electrically lighted.

The water works system consists of a gasoline, horizontal type engine, which pumps water from a well into a compression tank which maintains a pressure of 40 lbs. per sq. in. For fire purposes, this engine is capable of generating 100 lbs. pressure, sufficient to throw a stream over the building.

The sewage system is epuipped with all modern appliances and empties into a septic concrete tank, placed some distance from the school.

This mission has been established by the Anglican Church. There is also a Roman Catholic mission at La Plonge, which is, if anything, slightly farther north and a considerable distance west of Lac la Ronge. There is also, at La Plonge, a water works and a lighting system similar to that at Lac la Ronge, except that the electric power is developed from a water wheel operating on one of the small rivers.

Concrete Bridges Show Deterioration

Reinforcement in Columns, Chords and Railings of Two Concrete Truss Structures Found to be Badly Rusted After Twelve Years' Service—Stability Seriously Affected

Indications of disintegration of the concrete in the handrails of two Nashville, Tenn., bridges led to a thorough inspection of the concrete in the approaches, columns, handrails, piers, etc., and it was found that although the structures had been in use only twelve years, serious disintegration of the concrete had taken place and in several of the columns and trusses the reinforcing steel was exposed and very badly rusted.

The two bridges in question were known, when built in 1910, as the Sparkman St. bridge and the Jefferson St. bridge although the former is now called the McGavock St. bridge. They are both over the Cumberland River with approaches over the low lands on either side. The channel spans are steel trusses resting on concrete piers with part of the approach in both cases being earth fill supplemented by long reinforced concrete viaducts of trestle bent type except where the Sparkman St. viaduct crosses several tracks of the Tennessee Central R. R. Here heavy concrete trusses carry the approach over the track. The bridges are practically identical as far as type of structure and specifications are concerned.

Design of Bridges

The concrete trusses mentioned above are of the bow-string, curved upper chord type with vertical posts but no cross-bracing. The bottom chord varies from 18 x 30 inches to 18 x 36 inches according to the span and is reinforced with eighteen 2⅛ inch rods for a typical span. This number is designed to take the horizontal component of the thrust and the concrete acts only as a covering material for the steel. The top chord follows practically the line of pressure of the equilibrium polygon resultant from the dead load and is practically all in compression. For a typical span the reinforcing in this member is eight ¼ inch rods and the section 36 x 40 inches. The viaduct, 1060 feet long, in the Sparkman St. bridge is of the trestle type ranging from 18 ft. to 50 ft. high. The spans are mainly 30 feet, supported by three transverse columns 24 x 24 inches for the longer columns and 20 x 24 inches for the shorter. It is in these approaches that the current difficulty is being experienced.

The first trouble that occurred was during the winter of 1913-14 when after a cold spell a large vertical crack was noticed in one of the main piers of the approach of the Sparkman St. bridge. Closer examination revealed the fact that not only had this main supporting pier spread open vertically, but the split also extended up through the pedestal on top of the coping supporting the main reinforced concrete floor beam at the junction with the cantilever arm supporting the sidewalk, also splitting the big floor beams. These cracks have since that time developed in a number of piers of the viaducts of both bridges but they have been successfully repaired.

Part of a report on the condition of the two bridges, made by Prof. Robert H. McNeilly of Vanderbilt University, at the request of Engineering News-Record and appearing in the News-Record of Dec. 8th. 1921 is reproduced below:—

Sparkman Street Bridge

West approach up to railroad—Main column shows disintegration in only a few places. At one point water stands at a column base and the sidewalk has sunken around the base, which leads me to suspect disintegration of the foundation. Near the centre of this approach the expansion of the floor system was not properly taken care of and structural strains caused the tops of several columns to split. This was repaired several years ago. Where these columns were tied to adjoining columns the concrete ties show cracks evidently due to structural strains. Upon the floor system, there is frequently evidence of distegration caused by the expansion of rusting reinforcment.

Bow string concrete truss over railroad— In two places the concrete has broken away and the heavy lower chord rods (2⅛ inches in diameter) are exposed for a distance of about 18 inches with heavy cracking extending at least 4 ft. along the rod. At one other similar place, the cracking is very pronounced and the condition just as bad. The disintegration takes place in the lower chord below the verticals and seems to be so located due to the water being led down the vertical at this point. In at least 10 per cent. of these points below the verticals in these trusses cracks show the beginning of such action. I could not get closer than 15 ft. to these points to inspect them, but I do not believe the trusses are yet in an unsafe condition, as the rods are very large and are heavily bolted through bearing plates at the ends, so they do not depend on the bond with the concrete for their strength.

Subsidiary stairway structures—All the stairway structures on west approach are composed of small members and are in a mose serious condition. It appears to me that they will fall down in a few years if something is not done.

East approach—At least 10 per cent. of the main 24 x 24 inch columns show exposed steel or badly cracked corners on the columns of the two outside rows where water reaches them. Fully 25 per cent. show incipient cracks. Cracks and exposed steel are also evident in the structural part of the floor system.

Handrail—On the entire bridge this is badly disintegrated. Whole panels of the verticals are gone.

* * *

Jefferson Street Bridge

West approach—Condition of columns, good. I found no evidence of reinforcement exposed. Condition of floor system about the same as in the Sparkman St. Bridge. I found one place where outer edge of sidewalk had disintegrated and fallen. Near the river after the columns were built, some heavy plain concrete walls were built as bumpers around the base of the columns. One of these was badly cracked and one wall about 12 x 50 in. x 30 ft. has broken and fallen entirely down. Where this has occurred one of the columns has been repaired but it is probable that this was broken by some blow or strain.

Stairway—Condition excellent compared with those of Sparkman St. Bridge. I noted only one place where reinforcement was exposed.

East approach—This is in the most serious condition of any part of the two bridges, except the hand rails and the stairway structures which do not affect the main viaducts structurally. At least 25 per cent. of the columns show exposed steel reinforcement. At least 40 per cent. are so badly cracked that one blow of a hammer will expose the steel; both inside and outside the columns are affected. These columns are 24 x 24 in. I measured one place where steel was exposed for 2 ft. and heavy cracking extended 1 ft. below to the ground and 8 ft. above the exposed portion. One of the reinforcing rods was calipered. The original diameter was evidently 1¼ in., the present diameter is 1 3/16 in., the diameter of the rod with the rust intact about it is 1 3/8 in., showing an increase in original diameter of 1/8 in. due to rusting. This approach also shows a bad failure in a cross strut which is hanging by the reinforcement. This is a structural crack, however.

Handrail—Early showed serious disintegration and was filled in solid by gun cement and sand. This has been fairly successful.

The breaking away of the concrete from the steel in the bottom chord of the trusses is perhaps the most serious of the defects enumerated above as the concrete here is merely to protect the reinforcing steel. The rusting of the reinforcing will very soon make the section of the steel so small that a collapse will result. Although the condition of the trusses is not as bad as that of the stairways, these latter do not affect the stability of the bridge as a whole and would not cause a stoppage of traffic.

Investigation shows that the structure was erected under careful supervision and inspection, the cement was carefully inspected and certified and the work was conscientiously executed. Moreover, the concrete was not a "sloppy" mixture as this work was done before the day of placing concrete by spouting methods.

The city has appropriated the sum of $12,000 to permit the city engineer to make the necessary repairs and the maintenance cost of these concrete bridges will be no greater than that of bridges built of other materials.

Contractors frequently require some method of holding ordinary wood screws in concrete, brick slate, stone, tile or similar material. One common method is to block the hole in which the screw is to be inserted with wood. Lead plugs are also frequently employed. Another device that is said to give exceptionally satisfactory results is the Rawlplug, manufactured by Inventions, Limited, of Montreal. Rawlplugs are manufactured tubes of stiffened longitudinal fibre strands, so interwoven as to be unaffected by weather change or moisture. Once a screw is in position, the whole fixture is immovable unless the screw is removed in the orthodox way.

Chuting or Wheeling for Concrete?

Factors Affecting the Choice of the Method of Placing Concrete—Comparative Costs of Different Types of Plant—A Report of the American Concrete Institute

The 1922 report of the American Concrete Institute's committee on contractor's plant, presented at the recent convention of the Institute, deals largely with the broad question of when chutes for concreting may and may not be used with economy. The report in this connection is abstracted below:

Analysis of Chuting and Wheeling Plants

The principal problem facing a contractor in his decision as to what kind of plant to use on a certain concrete structure is in choice of the means of placing concrete by means of wheeling or chuting. This decision once properly made, the other details of plant layout such as location of plant or arrangements for receiving materials, may be properly determined by similar method of analysis for either case.

The effectiveness of wheeling is limited chiefly by the distance which it may be necessary to wheel from the mixing plant.

Starting with the lowest cost for placing concrete in front of the mixer, the labor cost per cubic yard will rise with each addition to the haul.

Chuting Plants of Two Types

Chuting plants are of two general types. The self-contained type, usually of about 100 ft. radius, is hung from the hoist tower by means of a suspended boom and counterweight chute. In the older or "line chute" method the chutes are suspended from a cable run between towers or between towers and anchorages.

The plant investment and installation cost, however, will vary with the distance to be spanned, for since the slope of the chutes with reference to the horizontal cannot be reduced below a certain fixed angle it follows that for long reaches there must be added to the cost of the extra length of chute a charge for the corresponding increase in the height of the tower.

Among other factors affecting the choice between the two methods of placing may be mentioned the character of the building; the cost of freight and repairs, the interest on investment and the kind of equipment which is available, as well as the amount of experience which local labor has had in concrete construction.

Chutes do not lend themselves as readily to all types of buildings, and it is here principally that the study is necessary. A nearly square structure is obviously best adapted for the 100 ft. radius type. The building should preferably have a high yardage or a number of stories, although "H" or irregular shaped buildings which may be enclosed in an approximate square can usually be handled as advantageously. Long narrow structures one or two stories high with low yardages are not adapted for this method of placing. With the same plan of building, but with greater yardage and more floors, one 100 ft. radius plant may be used to pour part of the building and by chuting to a floor hopper out 100 ft. off the wheel required to reach the rest of the building. Two independent 100 ft. radius plants may be used, or one mixing plant mounted on both towers.

The first step is to find out whether the job is one to which chutes will lend themselves without forcing. If by a general inspection of the conditions such is found to be the case, it is then proper to outline a plant layout for each method of placing and make an analysis of the advantages and disadvantages of each.

Costs Involved in Choice of Plant Type

The next step in the decision as to which type of plant is economical and suitable for a certain piece of work is to determine as accurately as possible the cost of each so that the one giving the lowest ultimate cost of mixing and placing concrete may be selected.

This ultimate cost may be separated for the purpose of analysis into the following items:

1. Rental of plant involved.
2. Installation—labor and material.
3. Maintenance of plant—labor and material.
4. Operating cost of plant—labor and material.

These four items will be explained more in detail as follows:

Item 1, rental of plant, is arrived at in several different ways by different contractors. The simplest, though not the most economical to the job, is to purchase suitable plant at the beginning of the work and sell it upon the completion of the job, and the difference between the purchase and the sale price then represents the charge to be made as rental of plant. This method of handling plant has several disadvantages other than lack of economy,—such as is the case in time of industrial expansion when suitable machinery might not be immediately available at the beginning of the work, or a period of depression at the end of a job, making it impossible to dispose of the plant without a great sacrifice.

The usual way to handle this account is for a general contractor to maintain a suitable plant yard and charge each job a rental for the items of plant furnished to the work. The amount of rental depends upon the value of the machinery and the rapidity of its depreciation and varies generally from 5% to 15% per month of its initial value. Motors, engines, hoists, etc., with proper maintenance, will not depreciate in value more than 5% a month. Mixers, boilers, etc., will depreciate 10% per month and concrete carts, chutes and like items of plan will depreciate up to 15% per month. Other smaller items, such as belting, shovels, wheelbarrows, etc., which are apt to be used up or destroyed during the life of an average job, are not generally considered as plant but as supplies and are bought by the job and any salvage value which they may have upon the completion of the work is credited to the part of the job for which they were purchased.

Where dealers are dependent upon whose business it is to rent out plant and where this practice is followed, the average cost to the job is 10% per month of the value of all machinery furnished.

The transportation of the plant including freight, trucking, loading and unloading, both to and from the job, is a proper part of the plant rental item.

Item 2, cost of installation, includes all charges for labor and material entering into the setting up of the machinery at the beginning of the work and includes the construction of storage bins, cement sheds, hoist towers, floor hoppers, run panels and such miscellaneous items as really form a part of the completed plant for mixing and depositing of concrete. This cost if installation also includes any additions to this plant or changes in the arrangement of the same which may be necessary during the operation of the job and also includes the cost of taking down the plant upon the completion of the work.

Item 3, maintenance, includes the cost of all labor and materials used in maintaining the plant in good working order such as repairs to bearings and other worn parts of machinery, painting and cleaning at the termination of work. To this item is also charged the cost of replacing parts broken during the life of the job.

Item 4, operating cost of the plant, is principally a labor charge, the only material entering into it being the cost of fuel, water, lubricating oils, waste, etc., and electric power in case electricity is used instead of steam. The labor in this item includes the actual operatives of the plant such as engineers, firemen, hoist runners, mechanics, etc., as well as the force of laborers employed in charging the mixer with the materials of concrete and the larger force of laborers employed in moving run panels or chutes, and those actually placing the concrete in the forms, whether it be by carryalls or chutes.

Choice Influenced by Labor Situation

Serious shortage in the labor market or a necessity for extreme speed in placing concrete, may influence the choice of plant as normally selected. The actual value of these two conditions can generally be determined with sufficient accuracy so that a proper weight may be given to their influence in changing any layout of plant normally decided upon.

Principal among the items common to both wheeling and chuting systems will be:

Towers and guy lines.

Mixers.

Hoist drums.

Hoisting buckets.

Electric motors or steam engines and boilers and electric wiring or steam piping.

Concrete carts.

Floor hoppers, gates, etc.

Run panels with horses etc.

In the case of a wheeling job, large numbers of carryalls will be used, with their necessary run panels and supporting horses, sufficient to reach the most remote part of the works. There will probably be a single drum type of hoist used, and the hoist tower and floor hoppers will be built of wood. The size of the wheeling gangs must be determined for the whole job, as that sufficient to take care of a little more than the average haul, which will be half way from the tower to the most extreme part of the building. The charging and placing gang will remain about uniform throughout the job.

In case a chuting plant is decided upon, the special equipped will be as follows:

Steel tower, with base and head frame.

Siding frame, with hopper.

Boom and counterweight truss.

Extension chutes.

Special hoist bucket.

Intermediate hopper or additional siding frame and hopper.

It is seldom found feasible to chute to all the remote points of the building, and the increasing objection on the part of engineers to the direct placing of concrete in the forms from chutes will tend to the use of floor hoppers and a short haul by carryalls, with the resulting use of a smaller number of carryalls and floor panels, rather than the elimination of the same.

The charging and placing gang will be about the same as where chutes are not used. The actual operators of the plant, such as hoist runners, firemen, etc., will be about the same, whether the concrete be transported by chutes or by carryalls. The cost of power, whether steam or electricity, is considerably greater for the chuting than for the wheeling plant, due to the increased hoist necessary.

If due to special conditions, such as the necessary transportation of considerable quantities of concrete long distances, it is decided that line chutes are more suitable; the special equipment will consist of, principally:

Main hoist tower, generally of steel and greater height than for either of the other layouts.

Auxiliary towers or heavy anchorages.

Line chutes and heavy supporting cables.

Special auxiliary chutes, with gates, taking off from the line chutes.

Special hoist bucket.

Heavy guy lines and anchorages for towers.

Heavier hoist equipment.

Summary of Comparative Costs

The summary of the cost of each type of plant will shape up about as follows when all items are considered, it being understood that the specific items of equipment given below are only for an example.

I.—Plant

Wheeling		Chuting	
Equipment	Depreciation	Equipment	Depreciation
Mixer, 1 yd.	20%	Mixer, 1 yd.	20%
Motor, 75 h.p.	20%	Motor, 75 h.p.	20%
Single drum hoist ..	20%	Double drum hoist ..	20%
100-ft. wood tower-ft. B. M. lumber at $— per M	100%	180-ft. steel tower	20%
Tower hoppers—ft. B. M. lumber at $—per M	100%	1 additional sliding frame with 54 ft. straight back hopper	20%
Run panels and horses—ft. B. M. lumber at $—per M	20%	600 ft. ¾-in. hoist cable	50%
1 yd. hoist bucket ...	50%	3,700 ft. ⅝ guy cable	50%
350 ft. ¾-in. hoist cable at	50%	20 turnbuckles	
1,500 ft. ⅝ guy cable at	50%		
12 turnbuckles			

Wiring or piping 100%

Wheeling		Chuting	
Concrete carts at....	50%	Sliding frame with boom and counterweight truss plant complete	20%
		Blocks and tackle for boom	5%
		Blocks and tackle for truss.	5%
		For moving sliding frame 1,080 ft. ¾-in cable at	50%

Also includes bins, bulkheads, conveyors, elevators, or other mechanical equipment forming part of set-up. Usually these items will apply equally to wheeling and chuting plants.

Interest on investment at 7% .... months.

II.—Installation

Excavation for grading for mixer, plus sheeting and backfilling.

Setting up and dismantling motor, mixer and hoist.

Wheeling	Chuting
Building and dismantling wood tower.	Erecting and dismantling steel tower, rigging, chutes.
Making run panels and horses.	

Erection and dismantling of bins, bulkheads, conveyors, etc.

Electrical, plumbing, and steamfitting work to connect up plant.

III.—Maintenance

Wheeling	Chuting

IV—Operating

Wheeling	Chuting

Fuel or power oil and waste.

Labor mixing, hoisting and placing:

Men charging mixer.
Men handling cement.
Men on mixer.
Hoisting engineer.
Fireman (if any).
Man on tower hopper

Men wheeling on floor.	Men in chutes.

Men spreading and tamping.
Foreman.

"I Am—"

By Frank M. Hinkle

I carry you from the frenzied trading place and lead you beside the running brooks.

I take you from the roar of the city's fevered mart, and lead you beside peaceful waters.

I carry you mile upon mile, away from dull care and humdrum monotony — through friendly meadows, and laughing flowers, and sparkling dew, into the sunlight, into the outdoors and the great open, and bid yon drink deeply from the fountain of a life that ever is!

I lead you under the soft clouds, piled up like mountain waves in a sea of wondrous blue.

I take you out and on and forever on, into sunlit realms of placid quietude: out where feathered choirs sing anthem and roundelay in the branches of a thousand trees — out where nature makes loving mockery of the vain artistry of man.

I take you through homey villages, through snug hamlets, through dale and dell and pleasant nook, through ever-stretching lanes far and away to the highlands where summits kiss the face of the sky.

I carry you over the spreading plains, over lowlands gently rolling, up and down the slopes, ever and on, everywhere and evermore.

Safely over high flung spans, looking down on torrents boiling and thundering — under great keystones thrown into nature's giant archways cut from the eternal hills — under frowning cliffs o'erhanging, where jut the defiant rocks of a million ages — onward I lead you, and onward still.

I carry you over the rugged mountains — beside crags upward rearing — under sturdy oaks — under the redwoods — through gorges and valleys and canyons — skirting the water falls where the glistening cascade has been tuned by the infinite to the music of the universe.

And beside the gentle river, where the voice of God speaketh ever to the answering heart of man and the purling waters whisper love to human kind — and thence to the tranquil lake, and on to the ocean's shore where the soul of man looketh out upon the vast unresting sea and saith unto itself, "Thou art of infinity!" — behold, I lead you on.

And thus I serve through all the passing years, and men do call me blessed evermore.

I am —— the Improved Highway!

The American Building Exposition, which has been twice postponed by reason of the incompletion of the building, will open the new municipal auditorium, Cleveland, Ohio, on April 22, to continue for a period of eleven days. The exposition will show every character of building material, interior decoration, finishing, furnishing and equipment, and an unusually interesting architectural display.

Hollow Tile Stands Up in Theatre Collapse in Washington

Investigations Show That the Failure of the Roof Trusses Did Not Cause Any Collapse of the Hollow Tile Walls Which Supported the Roof Members

The collapse of the roof structure of the Knickerbocker theatre on Columbia Road & 18th Street, N. W., Washington, D. C., on the night of January 28th, taking the lives of ninety-eight persons, has resulted in a most sweeping inquiry and investigation as to the reasons thereof. The Contract Record intends to report the results of these inquiries in a later issue but in the meantime the following reference to the disaster in "Building Supply News" is interesting.

At least five independent investigations by nationally recognized authorities have been completed since January 28th. Each one of these authorities has been able to trace the secondary cause of the roof collapse to the fact that the main roof slipped or was pulled off its I-beam seat.

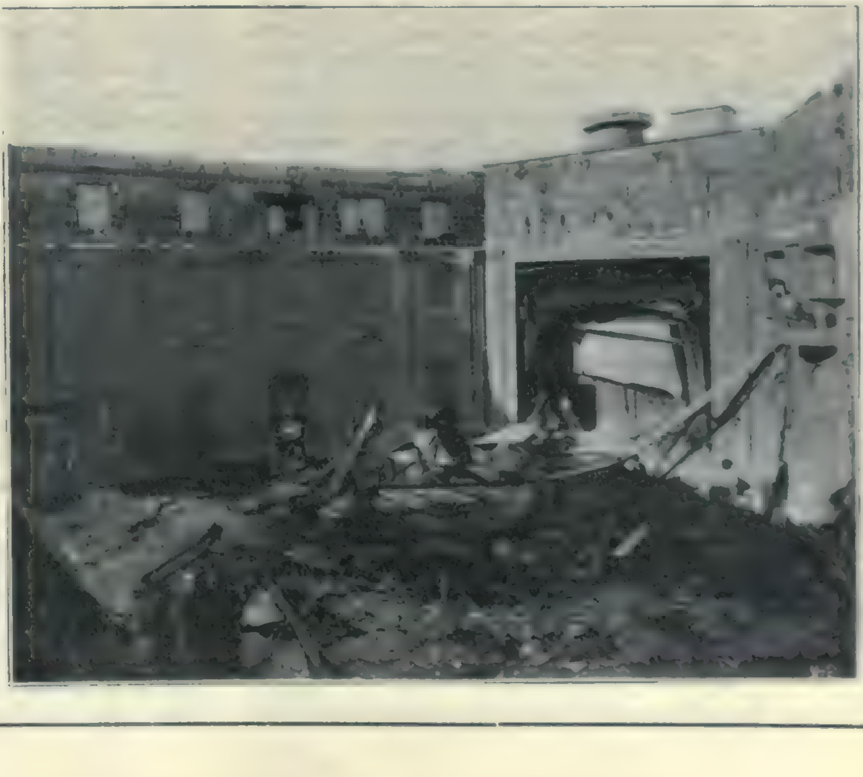
It was supported at the south end on a steel column and at the north end on a 20-in. I-beam bearing plate bedded into a hollow tile wall and into which four secondary roof trusses were framed. There are two or three differences of opinion as to the first failure in the steel structures, all of which are possible causes of this failure.

Colonel Wm. Kelly, representing the Committee of Army and Navy Engineers, appointed by the district attorney to investigate this theatre, reports in testimony before the coroner's jury that if the steel framing roof structure had been properly designed, properly fabricated, properly erected, the failure of one or two beams or purlins would have been entirely localized and would not have caused the general collapse of the roof structure as a whole, in spite of the fact that this roof structure was almost entirely supported on hollow tile walls. Colonel Kelly also reported that a sample of the poorest quality of tile that he could find on the job was sent to the Bureau of Standards for testing, which was reported as showing a strength far above ordinary requirements.

The exterior bearing walls in the Knickerbcoker Theatre were built of hollow tile (20 inches thick at the bottom and 16 inches thick at the top) faced with 4 inches of limestone veneer in the first storey and 4 inches of face brick veneer in the second and third stories. The facing was not bonded to the hollow tile backing with the commonly recognized masonry bond; galvanized iron anchors were simply used to tie the veneer with the backing. These walls are approximately 40 feet high and the Columbia Road walls follow the arc of a circle and is approximately 115 feet long from the intersection of the stage wall to the rear corner of the theatre. In this Columbia Road wall was built a 20-inch I-beam, approximately 8 ft. long, which served as a seat for the one end of the main steel truss, which carried a concentrated load of 102,000 pounds.

The photograph shows the interior of the Knickerbocker Theatre looking in a northwesterly direction

Interior of the Knickerbocker Theatre, Washington, D.C., after collapse of the roof, showing the walls remaining intact.



taken shortly after the roof structure had collapsed, which shows that hollow tile was used in the construction of these exterior walls. The holes or slots in the tile walls indicate the position of the steel roof trusses and beams which clearly indicate that if the ends of these steel members had been anchored to the tile walls they would have pulled off portions of the tile wall with them in falling. However, this was not the case and the roof structure was permitted to fall, leaving the tile walls standing intact in almost as good a condition as the day in which they were erected, which is clearly shown in this photograph. This appears to be the best testimony for hollow tiile construction that has yet come before the public eye. Under ordinary conditions the collapse of the roof structure which failed as this structure did, that is one side first, followed by the other side, would have pushed over the wall entirely. But in spite of this severe test on these tile walls the fact remains that the walls are still standing as a monument to good masonry materials and construction.

Flexibility in Pavement Construction

Rigid Types Are Not So Greatly Favored — Fillers for Brick or Granite Surfaces Are Also Flexible — Old Gravel or Macadam as a Foundation for Higher Kinds of Topping

By PREVOST HUBBARD
Chemical Engineer, The Asphalt Association

Before the Conference of County Road Superintendents and Engineers of Ontario.

Although I have not had a chance to study the development and present status of highway work in Ontario, from what I have heard and understand to be the present situation, I believe the province is to be congratulated on what has already been accomplished and upon the future possibilities which are directly dependent upon the work it has already done. I am informed that there are in Ontario to-day some 27,000 miles of hard-surfaced roads, which is nearly 10% of the present total mileage of such roads in the United States. According to the latest data that we have been able to secure, we have estimated that on January 1, 1920, there were in the United States, outside of municipalities, about 256,000 miles of roads of a higher type than earth or sand-clay, and the mileage to-day is probably not much greater than 275,000. The area of Ontario is about 11% of that of the entire United States, and its population less than 3%. It, therefore, appears that Ontario has almost as much mileage of hard-surfaced roads, per unit area, as the United States, and per unit of population about three times as much.

In the adoption of improved types of highways higher than gravel and macadam, I believe, we in the United States are still in the lead, as we estimate that about one-fifth of our hard-surfaced country roads are of these higher types, while the same is true of considerably less than three per cent of the roads in Ontario. While gravel and macadam roads are not as permanent in character as the higher and, for first cost, more expensive types of highways, they are undoubtedly the most economical to adopt up to a certain traffic limit. They, therefore, constitute an extremely valuable asset to the community which they serve, and represent an investment well worth conserving. Such a policy of conservation has, I understand, been adopted by the present Provincial Highway Department. When developing a system of heavier traffic highways, in many cases it becomes possible to utilize the existing gravel or macadam roads, so as to make their replacement value practically a permanent investment.

Paving Practice in the Cities

It may be of interest to review a few facts in connection with the development of the heavier traffic highway systems in the States, and in this connection the experience and practice of our cities should not be overlooked. To me it is an almost incomprehensible fact that in building our state and county highway systems more weight has not been attached to paving practice in our cities where many of the problems of meeting heavy and varied traffic conditions were successfully solved before such conditions made their appearance on country and suburban highways. In our cities the original waterbound macadam and gravel roads have for the most part given way to higher types of construction until to-day they constitute an average of only about 26% of the total yardage. The three most widely used city types are asphalt, brick and stone block. If we eliminate the waterbound pavements we find that of the higher, city types, asphalt constitutes about 55 per cent, brick about 19 per cent and stone block about 14 per cent, giving a total of 88 per cent of these three types.

In connection with the preponderance of asphalt pavements, the present trend of paving practice in the constructive modern brick and stone block pavements is of considerable significance, as it recognizes a principle which just now is attracting a great deal of attention on the part of our highway engineers. I refer to the use of a flexible joint filler for brick and block pavements as against the rigid grout fillers formerly so popular. Such cities as New York and Philadelphia are now using asphalt for heavy traffic streets paved with stone block, and both the Paving Brick Manufacturers' Association and the Association of Stone Brick Manufacturers are preferentially recommending asphalt as a filler for their respective types of pavements. The reason for this lies in the fact that absolute rigidity in a pavement structure is not a desirable characteristic. Service results and comprehensive field tests conducted by the U. S. Bureau of Public Roads have demonstrated that the brick or block pavement with a flexible filler is more resistant to traffic than with a rigid filler. A certain degree of flexibility is highly advantageous in meeting the heavy impact of modern traffic. Such flexibility is an inherent characteristic of bituminous pavements and is imparted to brick and block pavements when asphalt is used as a joint filler.

While in certain sections of the country the experience of our cities appears to have been overlooked, it is a fact that the flexible or semi-flexible types of construction predominate in our country roads and if we consider the total mileage of state, county and municipal highways higher than gravel and macadam, considerably more than 50 per cent may be classed as flexible. By reducing all yardage to a basis of 16-ft. width, we estimate that at least 45 per cent of the mileage of the higher types of pavements are of the hot-mix asphalt types. Our latest available information indicates that last year the total area of asphalt pavements constructed approximated 68,000,000 sq. yds., which was greater than for any other type. Most of the stone block pavements constructed that year were filled with bituminous material and we are informed that about 60 per cent of the brick pavements were similarly filled.

Flexible Types Preferred

There are, it is true many advocates of the all rigid monolithic types of construction and in certain sections such pavements predominated in last year's. work. This is not true, however, of the country as a whole. Those who favor rigid construction have constantly been obliged to increase the massiveness of design of such pavements, and also the amount of reinforcement in an endeavor to successfully meet the destructive action of heavy traffic, while those who favored the semi-flexible or flexible types have in general found that the old standards of design have proven satisfactory. The all-flexible types, such as the black-base pavements so extensively adopted in our far-western states, appear to be the most highly resistant per inch of total thickness, and may therefore be considered the least massive and in this respect the most efficient, of the heavy traffic pavements.

It is probable that such pavements will be given considerable attention in the 1922 program of some of our eastern states owing to the remarkably satisfactory results obtained over a long period of years in the west. Many of these pavements are 6 in. or less in total thickness.

What we have learned in the past few years about the destructive affect of traffic impact and the resistance to impact offered by semi-flexible and flexible highway structures has a peculiar significance in connection with a great economic problem that of conserving our investment in old roads, particularly gravel and macadam, when it becomes necessary to adopt a higher type of wearing surface. Prior to the careful investigation of this important subject there existed a marked and growing tendency to discredit the use of old gravel and macadam roads for foundations for the higher types, and this in spite of many remarkable service records of macadam foundations. For example, in the city of New York a number of the most heavily traveled streets were constructed years ago on macadam foundations and some are still giving satisfactory service. In 1890 Broadway between 59th and 79th streets was paved with asphalt over an old macadam base and for 22 years gave good service. Its replacement at the end of this period was largely due to subway excavations. Paved in a similar manner, 72nd St. gave 22 years of service under increasingly severe traffic conditions, and the same is true for a 19-year period for Fifth Ave. between 110th and 120th streets. Lennox Ave. between 110th and 124th streets was surfaced with asphalt over old macadam in 1904 and is still giving good service. The cost of maintaining this section in 1919, or 14 years after construction, was only 1%—certainly a remarkable record. I have mentioned these few examples, only for the purpose of illustrating the point. Many similar cases might be cited from various localities.

A recent investigation of rolled stone bases for brick pavements was conducted by the U. S. Bureau of Public Roads, and A. T. Goldbeck, of that Bureau, has published a very favorable report on this type of brick construction. All in all it appears that the old waterbound base is again coming into its own.

One reason for much of this former dissatisfaction with such bases was undoubtedly due to a fault which has been all too prevalent in the rapid development of our country highway systems. I refer to inadequate preparation and drainage of our sub-grades, fostered by the false idea that the cost of such work would make the total cost prohibitive. Political pressure and popular demand for the rapid construction and greatest possible mileage of improved roads for a given amount of money, was to a great extent responsible for this state of affairs. I am pleased to say, however, that this subject is receiving an increasing amount of attention and is being most carefully investigated by the U. S. Government and a number of public service bodies and technical societies, the work of the various organizations being correlated by the Advisory Board of Highways Research of the National Research Council. I believe that most of our highway engineers are now fully alive to the importance of this subject and that marked improvement in our present practice of sub-grade preparation and drainage will shortly follow.

Others frequently see our faults before we, ourselves fully realize them. The deputy minister of highways of Ontario tells me that for a long time he has believed that the failure or unsatisfactory condition of many of our highways is due to their having been constructed in one operation, and that much of our sub-grade troubles can be attributed to this fact. I think I can fully agree with him in this matter, particularly in view of our lack of information on subgrade conditions prior to construction. Without such information rapid development of a higher-type highway system is almost sure to result in many costly failures.

Grading in Advance of Surfacing

I understand that the present policy of the Ontario highway department is, where new construction is contemplated, to grade the roads a year in advance of surfacing; then where traffic conditions do not immediately demand a higher type, to surface these roads with gravel and macadam, with the ultimate idea of utilizing such roads as foundations for more resistant wearing courses when they become necessary. I believe this policy to be thoroughly sound as it gives opportunity for hunting out and correcting all existing sub-grade troubles before the more expensive surfacing is laid. Such a policy may, and I understand has, caused some dissatisfaction on the part of those who are over-anxious to see and travel over the completed highways at the earliest possible moment, but I believe the great mass of the people may be educated to appreciate the fact that this policy ultimately means more and better highways for a given amount of money.

In conclusion, I wish to call attention to just one other matter which has been a very common fault in our work and has often resulted disastrously. This is the over estimation of thickness of the old road when it has been decided to utilize it for a foundation. All too frequently we have laid an expensive pavement on an old road actually three inches or less in thickness when it has been estimated as not less than 6 or 8 inches thick. Macadam and gravel roads wear away very rapidly in comparison with other types, and because records show that a large tonnage of road metal has been used in the construction and maintenance of the old road, it does not by any means follow that most of such material is still on the road. It is very essential, therefore, to determine accurately the existing thickness of the old road before utilizing it as a foundation.

I believe that wherever possible the old road should be left undisturbed rather than to scarify and reshape it, which destroys much of the stability that compression under traffic has brought about. It is quite necessary that the old surface be trued up before the wearing course is laid; but if the reconstruction is to be completed in one operation the placing of the bituminous mixture in existing depressions will usually prove to be the best practice. If the existing road is not sufficiently thick to serve as a foundation, it may conveniently be reinforced with a thin course of black-base mixture before the wearing course is laid.

Contracting Problems Discussed by Montreal Exchange

Scaffolding Licenses Are Not Favored — Guarantee Bonds and Certified Quantities Advocated

Several matters of interest were discussed at a general meeting of the Montreal Builders' Exchange held on March 15th, under the chairmanship of K. D. Church.

D. K. Trotter, the secretary, reported that he had been assured by Jules Crepeau, the city executive director, that the city would co-operate with the exchange in the matter of notifying the latter of any changes in the building by-laws.

A. Leclaire brought up the subject of the scaffolding law passed last session by the provincial legislature. This provides that in the case of scaffolding of 15 feet and over a license must be secured and the scaffolding inspected. The discussion brought out the opinion that in view of the fact that the contractors insured their workmen the law was unnecessary. The inspection and the expense only meant delaying work and adding to the cost of construction. It was decided that the secretary should take the matter up with the provincial government with a view to the repeal or modification of the act.

The secretary stated that he had brought to the attention of Mr. Crepeau the subject of the city accepting guarantee bonds instead of certified cheques in the case of contracts with the city. The chairman was in favor of guarantee bonds such as are accepted by the Dominion and provincial governments. A. Plamondon pointed out that a certified cheque involved the tying up of the money for a very long period; that the money had to be borrowed from the bank at, say, 7 per cent; and that guarantee bonds could be obtained at 3½ or 4 per cent. Bonds were not only cheaper but were at least as satisfactory, so far as security was concerned, as certified cheques. Messrs. A. Leclaire, M. Chouinard, and J. Quinlan were appointed a committee to take up the matter with the city and the insurance companies.

Guaranteed Quantities

Considerable discussion took place on the subject of architects furnishing guaranteed quantities. J. A. Francoeur opposed the idea, while Mr. Plamondon supported it. He advanced arguments in favor of quantity surveying, pointing out that the present system of each contractor figuring the quantities involved tremendous waste. This waste had to be paid for by someone and, of course, it went to the cost of operating. If guaranteed quantities were supplied by architects, each contractor would be on an equal basis in competing, and the test would be the efficiency of a contractor in securing the work. The system which now prevailed did not make for the best results. R. F. Dykes was in favor of quantities being guaranteed by architects; this subject had been discussed several times, and he suggested that the exchange again take it up with the Provincial Architects' Association. The chairman stated that a suggestion had been made, in connection with the General Contractors' Association, that a separate company be formed to undertake quantity surveying for subscribers. He understood that the English-speaking architects objected to supplying guaranteed quantities but would favor the formation of a company for that purpose. Such a company would be of value in adjusting any differences between architects and contractors. It would, of course, be necessary to form a section for such subtrades as plumbing, and electrical contracting, etc. J. A. Anderson welcomed any scheme which would help electrical contractors in the matter of tendering. At present there was a large loss because of lack of a recognized system of quantities. Mr. Anderson also referred to the law, which is about to be enforced, compelling the licensing of electrical contractors and journeyman. It was agreed to refer the subject of quantity surveying to the various sections interested a report to be made at the next general meeting.

Standardizing Lumber

The necessity for a system of standardizing lumber was briefly discussed. The chairman stated that while there were standards for cement and other building supplies, there was none for lumber, and that contractors had no remedy when they received lumber which did not come up to expectations. Mr. Plamondon argued that such standardization would be of benefit to the contractors and to the lumbermen, in that it would be a guide to both buyer and seller. A committee, consisting of Messrs. Woodruffe, Daigle, Plamondon and Leclaire, was appointed to study the matter and communicate with the local and national lumber associations.

Mr. Plamondon reported that he had received a visit from the secretary of the Professional Engineers of Quebec, who stated that the Association was trying to secure the repeal of the ten years' guarantee of a building by architects, contractors and engineers. It was the intention to ask that the law be modified and brought into line with the three years' guarantee existing in Ontario and other provinces where architects and engineers were exempt. The chairman remarked that the Quebec law was more onerous than in any other province in Canada or state in the United States. The secretary was asked to communicate with the Provincial Architects' Association and other bodies with a view to concerted action in securing a modification of the law. It was mentioned that the Provincial Association of Builders' Exchanges had had the matter under consideration.

Complaint was made of the law requiring a contractor in Montreal to arrange with the city and the Tramways Company when making a connection with a main sewer under the tracks. This involved paying double permit fees and filling out unnecessary papers. The matter was referred to sections of the exchange interested.

The meeting concluded with a short discussion on how to increase the membership of the exchange.

Metal or Wood Forms for Concrete?

Committee of the American Concrete Institute Outlines Points to be Considered by the Contractor Before Deciding on Type of Forms to be Used in His Concrete Operations

The special committee of the American Concrete Institute on the application of metal forms to building construction, emphasized in its progress report submitted at the Institute's convention, the need for a careful study of conditions for each job before making a decision as to the kind of forms to be used. No sweeping generalizations are possible, the report stated, a factor of minor importance on one job may be of major importance on the next.

Some of the points to be considered by the contractor before committing himself to either wood or steel forms are given as follows:

I. General:—

(a) Cost of materials; labor making, erecting and stripping form centering.

(b) Rental cost of metal form panels.

(c) Cost of erecting and stripping metal forms.

(d) Will the metal forms be delivered to the job in time to avoid delay to the construction work?

(e) Will the use of metal forms require employing a mechanical trade not otherwise needed on the building, and if so, will this possibly lead to labor complications.

(f) If metal forms are handled by sheet metal trade and carpenter labor is scarce, labor conditions may be improved by the use of metal forms.

(g) Will the use of metal forms necessitate purchasing lumber for various other purposes, such as bucks, grounds, bulkheads, etc., for which old form lumber is originally used?

(h) If metal floor forms are used, can they be utilized also for wall forms, saving the cost of wood, although the cost for labor on metal forms may be high?

(i) If wood forms are used for walls, will the excessive material cost overbalance possible economies otherwise offered by metal forms?

(j) Will the smooth surfaces resulting from the use of metal forms be desirable as giving a better apperance, reducing the cost of pointing or painting or other finishing, or as giving results in any way for which the owner would be required to spend additional money if wood forms were used?

(k) Will the smooth surfaces, or the possibility of their being oil-soaked, be detrimental and require the expenditure of money for special treatment preparatory to painting, plastering or otherwise finishing the surfaces?

(l) Winter weather construction. Metal forms to a slight extent lessen the fire hazard where salamanders are in use, and because of the heat-conducting qualities of the metal make it easier to keep the poured concrete above 70 degrees while setting.

II. Rental Basis:—

If the general contractor rents the metal form panels and erects with his own labor, the following points should also be considered.

(a) Will the use of metal forms cause labor difficulties due to jurisdictional disputes as to which trade should handle them?

(b) If metal forms cannot be handled by carpenters, will this disorganize the labor forces by necessitating intermittent hiring and discharging the different trades, or can the job be organized to give continuous employment to all trades, thus making employment attractive to the best workmen?

III. Sub-Contract Basis:—

If the erection and handling of metal forms is let on a sub-contract either to the form manufacturer or to an outside erector, the following points should be considered.

(a) Will the introduction of another sub-contractor tend to slow up the progress of the job and therby result in an increased cost of any part of the work? On rush jobs this question of the general contractor losing the absolute control over the speed of the work that he has when all the form-work is done by his own organization, may be of extreme importance.

(b) Will the introduction of another sub-contractor tend to simplify or complicate the labor situation? If local labor is scarce, bringing in an outside organization may relieve the situation somewhat.

(c) Can the sub-contractor be depended upon to co-operate with the others to the best advantage of the job as a whole; or will his presence (since he will be primarily interested in the cost of his own work), tend to increase the cost of other work?

The committee reported that the opinion among contractors seems to be unsettled on the question of superiority of ceiling finish obtained by the use of metal forms. The joints are less in number, and some feel, therefore, are more conspicuous. There are no costs available to show whether there is any saving in pointing charges on the ceilings.

Combatting Restricted Production

Revision of Methods Can Increase the Output of Building Labor and Cut the Cost of Construction—Men Better Satisfied and Better Paid

By SANFORD E. THOMPSON
Of the Thompson and Lichtner Co., Boston

At the annual meeting of the Associated General Contractors of America

My first construction job was that of foreman of a gang of laborers tamping concrete, and later, as foreman of a gang of trench back-fillers. This was in 1886. I well remember a discussion in the hotel parlor of the little town where the work was going on. The contractor and his foreman and the engineers were talking together. The question was whether a man could be a successful foreman who did not swear at his men. There was little discussion, because it was the unanimous conclusion that a foreman was utterly worthless unless he could damn his men up hill and down. I venture to say, and I think the older men will agree with me, that if at the present time you should hire a typical foreman of the '80's or the '90's not a laborer would stay on the job.

However we may sneer at this olden type of drive, drive, drive, it did furnish a certain, although sporadic, incentive to the workmen that is lacking today. It often got the work done quicker and cheaper. Besides this loss in effectiveness through the giving up of a practice which at the heart was brutal, we find some trades, perhaps partly as a result of these drive methods, restricting output in serious fashion, while, in general, more work could be accomplished without detriment to the workers.

More Work—Better Work

What can we do about it? Our war days are over when it was humanly natural for a man to work slowly because he was so sure of his job. We have come to a time when the very existence of our living standards demands greater and greater production per unit of population. In construction this means larger daily output per worker. It means less lost time. It means especially more continuous work through the season and through the year.

It will be of little value to devote our time to an enumeration of restrictions that are being practiced by labor or by employers, for every contractor and material man is restricting output just as truly as the workman when they reduce the amount of construction work through abnormally high prices. Instead, with only a brief reference to these, it will be more useful for us to consider the prevention of the evils.

In connection with the restrictions, however, I want to refer to one illustration in the report on Elimination of Waste in Building Construction. This shows the labor costs of seven similar concrete buildings, all erected by the same contractor, in per cent. of estimated labor for the trades as indicated.

Restricted Output Raises Cost 114%

Now, two out of these seven buildings were built under conditions where the labor was actually restricting the output. The cost of forms in these two buildings averaged 101 per cent. above the estimate, whereas in the five unrestricted projects the average excess (all these were built in war time) was 26 per cent. In labor on reinforcing steel there was still greater difference, one of the restricted projects costing 138 per cent. above the estimate, while the other five averaged 13 per cent. above.

Also, I do not feel with a subject of this kind that we should let the recent happenings in New York City entirely pass without reference. In reply to a request to the secretary of the Building Trades Employers' Association, I received a typewritten copy of the Untermeyer requirements of the unions of New York City, in which are included reference to a number of the points brought out in our report on the Elimination of Waste in Industry.

Untermeyer's Requirements

For illustration of the subject, we have briefly summarized a few of Mr. Untermeyer's requirements as follows:—

Removal of restrictions on membership of any who can qualify under reasonable regulations as to character and capacity.

Limitation of the amount of initiation dues to a reasonable amount.

Repeal of rules limiting number of apprentices.

Formulation of amendments to by-laws preventing unions from fining employers under penalty of refusing union labor.

Repeal of practices that restrict builder from use of approved appliances or from doing work at the shop instead of on the job.

Repeal of regulations punishing employers or union men for "rushing" or "driving." The requirements state in this particular that "every member should be left free to do as much work as he sees fit to do in a working day. The men should be encouraged to efficiency instead of being fined and discouraged. The regulation is thoroughly demoralizing and undemocratic, and is destructive of initiative, ambition and individualism. It tends to make slackers and laggards of the men and to deprive them of their self-respect. It measures the best and most upright of them, who want to do an honest day's work for a day's pay, by the standard of the laziest and poorest of his associates and renders the men fearful instead of ambitious to do an honest day's work. There is nothing in all the history of organized labor that is so destructive of the morale of the men and so injurious to the cause and repute of labor. The struggle should be for effciency. This regulation puts a premium upon efficiency."

Union constitutions empowering prohibition of more than five-day week should be amended.

Practice of prohibiting plumbers' helpers using tools must be abolished.

The limitation of a paint brush to four and one-half inches in width must be repealed.

Use of approved machinery and approved methods must be permitted. Cases cited by the attorney bearing on such restrictions that must be abolished are:

- Mixing of reinforced concrete in shop.
- Compelling an employer to finish his ceiling with wire lath regardless of specifications.
- Prohibition of use of casts in plastering.
- Requirement that plastering models must be destroyed after one use.
- Preventing mixture of plaster-of-paris with Keene cement.

The Unions' Point of View

Even if we consider most of these union requirements as absurd and illogical and uneconomic, what is the reason for their being, and how can we get at the underlying principles sufficiently to eradicate the point of view on which they are based? In manufacturing, where soldiering commonly occurs, the cause is frequently evident. For example: In conversation with the manager of a plant making rubber specialties he complained that he was unable to get enough output out of the men even on piece work, and that they limited their production to certain definite accomplishments and worked at day-work pace. Further conversation, however, brought out the fact that the piece rates were originally set by guess, aided by records of day-work production, and that he had already cut the rates four times. One could not blame the workers for restricting output when they knew that it would result in the management requiring more and more work with no pay.

This condition, however, does not apply directly to the building industry. The reason is often given, sometimes in good faith by the union, that they limit output so as to prevent poor workmanship. This has a counterpart in the feeling of the manufacturer that he cannot introduce piece work or work his men at fair speed because of the danger of affecting quality. Both the union men and the manufacturer are wrong. Speed, unless carried to extreme, does not produce poor quality. In fact, we might cite case after case of actual investigation where we found the speediest men were the best workmen.

A case of that kind came up only recently. I was visiting a plant where they make paper specialties. There were some 50 girls running a group of machines, some of them turned out 60,000 pieces per day and most of them turned out around 40,000. I asked about the quality. "Why," they said, "we get the best quality from the 60,000 girls. They make perhaps 1 per cent. waste, whereas those who run down to 20,000 or 30,000 run up to a 4 per cent. waste."

Good Day's Pay if Good Day's Work

Getting right down to fundamentals: is not the trouble in the first place the lack of appreciation by the workers of the necessity for doing a good day's work in order to maintain a good day's pay, and, even further than that, the actual belief on the part of many of the workers that it is incumbent upon them to work slowly in order to make the work go around?

Here again is a counterpart in manufacturing with the manager who restricts his output in order to raise prices, forgetting that it is more profitable to sell in quantity at a small profit than to sell fewer articles at high prices.

Assuming that these are fundamental causes of restriction, they must be counteracted in three ways: (1) by education, which involves a considerable period devoted to the teaching of fundamental economic principles, (2) by the establishment of some plan of inducing the workmen to greater production, and (3) by the determination of actual time standards so that the employer will know just how much work a man ought to accomplish for a fair day's work, taking into account the variations and conditions that occur.

We believe the thinking leaders of labor to-day really appreciate the necessity for eliminating restriction of output, although actions are not always in accord with this point of view.

Method Substituted for Brute Force

I have referred to the "drive" methods of the past. In the factory there were similar conditions. Let us see how they were met and whether the methods adopted are applicable to construction. In the factory, for the "drive" method which reacted toward slowing production, is being substituted more definite methods of planning and controlling the work done with more intimate knowledge of what a man can do, how much can best be done, and in what sequence. In other words, method is being substituted for brute force. This definite control and knowledge of what is being done makes it possible to give incentives to the men—financial and, in some cases, non-financial.

As an illustration, take an Ohio rubber plant employing largely unskilled labor. It was found by thorough analysis of the operations themselves, and rearrangement of the gangs that it was possible to increase the output per man some 40 per cent.

You say that factory work is different from construction; that they have the same men month after month and year after year; that the processes are routine instead of changing from job to job. The best answer to this is that similar results have been accomplished in construction work and as successfully as in the factory.

Cost Halved by Scientific Methods

On one concrete construction job, by the use of what might be termed scientific methods a six-story concrete building 600 feet long by 200 feet wide was done at practically one-half the cost of the same work formerly handled by the same construction company under the old methods, and this notwithstanding the fact that under the old methods they had made a detailed study of their costs for several years to reduce them as low as possible. The saving then was due directly to the application of the more scientific methods.

In house construction similar results have been produced. In one case where scientific methods were installed by a residential building company and the carpenter work laid out so as to give definite jobs to each man, with a liberal reward for accomplishment, two buildings out of a group of twenty about to be constructed, no two of which were alike, were selected to compare work by day labor with that handled by scientific management methods.

On these two houses all the carpenter work was handled by straight day labor and the carpenter foreman selected for the job was the most experienced foreman in the employ of the company; in fact, he formerly had sub-contracted for this work at low cost. The other eighteen houses were built by improved methods of management, the carpenters being paid a bonus for accomplishing the work laid out for them in the required manner and time. On the houses built by the ordinary day-work methods, the increased cost of the work over that obtained on the other eighteen houses with the improved methods was as follows:

Setting of first floor joists cost 78 per cent. more than with improved methods.

Erecting first floor curtain walls cost 26 per cent. more than with improved methods.

Erecting second floor curtain walls cost 16 per cent. more than with improved methods.

Erecting first floor sub-floor cost 54 per cent. more than with improved methors.

Erecting second floor sub-floor cost 59 per cent. more than with improved methods.

In the work of common laborers, such as trenching and backfilling for sewers and water pipe, large reductions in cost have also been effected. For example, in a case where the digging was of an exceptionally hard and varied character, being a very stiff, tenacious clay, the following results were obtained:

Operation	Unit Cost Ordinary Methods	Unit Cost Improved Methods
Excavation . .	48.0c. per cu. yd.	34.8c. per cu. yd.
Pipelaying . ..	11.1c. per lin. ft.	4.5c. per lin. ft.
Backfilling . ..	34.6c. per cu. yd.	10.6c. per cu. yd.

These results have not been due, as might be thought at first sight, simply to requiring the workman to do two or three times the amount of work he formerly accomplished, but, in a large degree, to thorough planning of the work in advance, studying the actual details of the work and teaching men how to perform their tasks in the easiest possible manner.

Features of Waste Elimination

The savings, then, were obtained not by merely hustling the work nor in any degree by slighting it, but to much more essential features of:

(a) Economical design and layout of construction operations.

(b) Laying out in advance the method of handling the work to reduce to a minimum the quantity of construction material.

(c) Selection of the best tools and materials.

(d) Arranging the processes to simplify the work and teaching the men how to do it in the best way.

(e) Designating in advance the amount of work to be done by each man.

(f) Giving the men a definite money incentive to encourage them to do a large day's work.

(g) Eliminating the time ordinarily lost by workmen, such as waiting for orders, waiting for foreman to lay out the work, waiting for materials, looking up tools, using improper tools.

An important feature of the plan developed was the payment of bonuses for accomplishment of the different pieces of work in the standard times estimated in advance. These standards were obtained by job analyses carried on similar to factory studies. In other cases, where bonus or piece work was impracticable, it has been found possible to attain similar results by the establishment of standard times for performance and keeping track of the actual time consumed by the men. Here it is necessary to allow, of course, a longer time standard than if done with an incentive and interest the men to keep up these standards.

The principle can best be illustrated by reference to the case of the rubber plant referred to above.

Output Increased 40 Per Cent.

Before getting this 40 per cent. increase in output per man, the methods of handling the work had to be worked out to see that the jobs were properly distributed to the men, that the materials came to the men at the right time, that the condition of the material was workable, that the quality was right and that conditions in general permitted the workmen to do an exceptional day's work.

This required detail analysis of conditions by special men trained in analytical study and the establishment of methods somewhat different in principle from those that had been used. In the house construction referred to, it was found that the making up of framing plans reduced the labor on the job; that, by sawing the lumber at the mill for the sills, studs, joists and rafters, not only time but a considerable amount of material could be saved; that by planning out the work, something as in a modern factory, the jobs were dove-tailed into each other and lost time was eliminated; that by figuring out in advance the time required for each operation and then paying a bonus for its accomplishment the men had a definite incentive to do their best work.

In other cases where it was impracticable to pay a bonus on account of union or other conditions, by the determination in advance of the time, allowing, as I have already said for less strenuous work than where a bonus is paid, similar results were possible. Even to get the advantage of standards of this kind, however, it is necessary to provide definite methods for controlling and keeping track of the work. It means increased overhead; it means more clerical work. But who can object, for example, to paying $25.00 for clerks, if by so doing he is able to save $100.00 in skilled labor and, at the same time, increase the speed of the job to a marked degree? That is what we all want to think of; not whether we've got two extra men on the job, but whether those men are making money for us by saving money somewhere else. I feel there is a large development possible in this kind of work in construction.

Co-operation of Unions Necessary

Such development requires the co-operation of the individual workman. Unless complicated by outside parties, this is easily obtained, but it must be worked out so as to make it advantageous for him to co-operate. With union labor, to attain the most complete results, the co-operation of the union must be obtained. Many unions are appreciating the necessity for standardization and of accumulation of facts in order to lay out and carry on work to better advantage. Even, however, without the co-operation of the union a great deal can be accomplished along the lines indicated above.

In undertaking the development of more effective methods, the viewpoint of the worker must be considered, particularly from the standpoint of eliminating the causes of irritation due to lack of proper materials, tools and equipment, waiting for work when on the job, and, particularly, the irregularity of employment throughout the year. The last, perhaps more than anything else, is a source of endless worry to the workingman.

Increased Pay to Offset Layoffs

In the building trades skilled and unskilled workers are actually employed from 60 per cent. to 80 per cent. of the time. This means not merely that nearly every workman is looking forward with dread to the day when his job is finished, but it means, also, that the employer is paying in actual wages from 25 per cent. to 66 per cent. more per day for his labor than if the men could work continuously. Did you ever think of that? If a man worked 60 per cent. of the year, as some of them do, he's got to have 66 per cent. more pay in order to receive the same amount of money per year; and, if he worked 80 per cent. of the time, he has 20 per cent. layoff (which is not at all excessive), and he has to have 25 per cent. more pay.

The money which buys food and clothes and lodging is not that which comes in by single days, but that which constitutes the annual income. In all adjusments of wages, either by normal process or by demand, this feature comes in automatically, although often unintentionally.

Seasonal work cannot be prevented by one contractor working alone, although certain contractors have been able to go much further than others along this line; but it can be reduced through organizations of builders and contractors working in harmony with labor. There are large possibilities for the establishment of bureaus or other co-operative plans where construction programs can be worked out in advance and activities coordinated.

What is needed in particular is intensive study and analysis of the causes that make for restriction in building trade developments and constructive outlines of means for effecting a cure. The aim must be to build more and more buildings, but with strict view to maximum economy and increased productive capacity per man—not through excessive labor, but with the aid of machinery and implements, and particularly, of methods adapted to the particular conditions.

Both workingmen and employers, furthermore, must study not merely details and technique, but must view the problems from the standpoint of fundamental principles of economics, principles which are not mere theories, but are based positively on facts, and must establish these as working programs. Construction will increase and develop in proportion to our ability to develop, in the first place, economies, and, in the second place, harmonious relation with our workmen which will provide them an incentive either financial or otherwise, to take hold from day to day and from hour to hour and to work in harmony with the employer.

Track Maintenance on the C. P. R. Let to Private Contractors

For Three Years During Labor Shortage and Heavy Traffic, a Departure Was Made in the System of Keeping Track in Repair—Methods Adopted Under the Contract Arrangement

A new field of operation for the contractor is indicated in an article in Engineering News Record describing how the Canadian Pacific Railway maintained 400 miles of its track under a contract arrangement. During the three years that this scheme was adopted the system met with such successful results as to warrant contractors making a bid for this type of work. The article which follows is by H. G. Harton, of the Sydney E. Junkins Co., Winnipeg.

Supplementing the regular railway section gangs by extra gangs operated by a construction company was the method employed by the Canadian Pacific Ry. for carrying on track maintenance at a time when the labor situation made it more practicable to handle the work through an outside company. The contract system was in use during 1918-1920 on the 400-mile stretch of double track between Winnipeg and Fort William. This division carries a large proportion of the traffic originating west of Winnipeg, and at certain times of the year, especially during the wheat movement in the fall, it is operated under extremely heavy traffic conditions.

Maintenance of track on this division presents a particularly difficult problem, due to the fact that the open season during which maintenance can be done effectively is short, usually from mid-April to mid-October. Further, the severe frost action and consequent heaving of the track largely increases the maintenance of line and surface, quite apart from the action of traffic.

The division lies through a region that is almost uninhabited except at either end, at the engine terminal points in Kenora and Ignace, and at a few small towns. The country is wooded, rocky and interspersed with lakes. Muskeg swamps are often encountered, which tend to cause soft track in spite of large quantities of fill. They also require ample drainage ditches, of which some 25 miles were dug during the work here described. There are a few short tunnels through rock points, a considerable number of culverts over the many small streams connecting the various lakes, and a few larger bridges such as those over the Lake of the Woods outlets and the Kaministiquia River. The profile is regular in general, with a rise of about 900 ft. from the level of Lake Superior to the height of land, then a gradual drop of about 800 ft. to the level of the Red River at Winnipeg. Curvature is considerable, especially in the lake sections.

Track construction comprises 80-lb. and 85-lb. rails with angle splice bars on ties 7 x 9 in. and 8 ft. long, laid in gravel ballast. Treated ties have been used as renewals in recent years for 160 miles east from Winnipeg. Shoulder tie plates are placed on curves and on all creosoted ties. Rail anchors are used at all points where the rails travel under traffic.

Contract Maintenance System

Ordinary maintenance work is done in the usual way by section gangs. Owing to the shortness of the working season, previously mentioned, it is necessary to supplement these gangs, even when filled to strength in the summer, by extra gangs. It is the work of these latter gangs that this article describes. The primary motive of the railroad in contracting outside for this extra gang work was to supplement its own meagre supply of common labor in the difficult three years covering the last year of the war and the next two years of readjustment.

Wage rates for track work were considerably lower than those prevailing elsewhere for industrial and construction work; the work itself was usually located many miles from towns or even telegraph stations; all living had to be done in outfit cars or tents. In general, in a time of severe competition for labor in every direction, the proposition involved a considerable element of selling the job to the laborer as more desirable than the many other opportunities he was being offered.

An outside engineering construction company with a flexible organization was thought to be capable of dealing with this kind of a situation somewhat more quickly and easily than the more rigid organization of a railroad. The undertaking, based on a prearranged fee, involved the primary motive that the work was to be done precisely as a department of the railroad; that is, that the construction company should merge its organization absolutely to the needs and direction of the railroad although at the same time keeping it entirely separate and distinct.

Organization and Supervision

Briefly, the organization consisted of a field office at Kenora, Ont. (the railway division headquarters), reporting to the company's main office in Winnipeg. The latter handled general relations, rates and the recruiting of labor. A field superintendent was primarly responsible for field work. Under him were assistant superintendents, paymaster, travelling timekeeper, camp inspector and, at the field office, a clerk, stenographer and tool man. Reporting each day by wire to the field office were the gang foremen. Under them were the assistant foremen, if the size of the gang demanded, and the workmen. A timekeeper accompanied the larger gangs and reported to the field clerk.

After determination by the railroad management, the major features of the work were administered by the direct engineer, the division superintendent of the railway and the field superintendent of the contractor working in close co-operation. The division superintendent passed his instructions to the roadmasters and these in turn conferred with the field superintendent as to the details of the work desired to be done on their respective districts. The contractor's field superintendent also attended the weekly meetings of the division superintendent and the road masters, where the various problems arising from maintenance were threshed out.

The net result of this organization was that the daily problems were promptly settled direct between the railway company's roadmasters, the contractor's field superintendent and the gang foremen, while the general policy, changes, additions or curtailments were settled between the district engineer, the division superintendent and the field superintendent, and were then passed on to the roadmasters and gang foremen. In reverse, questions were passed up by the two latter parties and adjudicated by the three principals above mentioned. The flexibility was especially desirable since over 800 miles of track were being covered, where conditions changed constantly and time was an important element.

Extra gangs organized by the contractor were similar to railway extra gangs. Owing to the nature of the country each unit was entirely self contained, having its own sleeping, dining, cook, store and tool cars. Gangs varied in size from 6 to 100 men. The boarding was done by R. Smith & Co., Winnipeg, who furnished the necessary help, dishes and food in cars supplied by the railroad. As good and sufficient board was a requisite in keeping down labor turnover the closest co-operation was established with the boarding contractor, in order to keep the latter advised of gang movements and strength and of the character of food and service. A second requisite was a clean camp with cars properly roofed and screened, well disposed sanitary arrangements and cook house waste, and a good water-supply.

These were all deemed fundamental requirements and were watched with the closest care. The field superintendent determined these points as his first duty in visiting a camp and any complaints of the men regarding them were at once investigated and, if justified, were promptly corrected. The medical officer of the railroad co-operated in all sanitation matters in addition to purely medical services. Since some one in authority was at every camp in short intervals, living conditions were strictly checked and many of the petty annoyances of the rough living in outfits were relieved.

Although labor during this period was often unreasonable the response of the men to these attempts in their interests was encouraging. In addition, inquiry was made of each man when quitting to determine the cause for leaving and in this way various minor troubles, not apparent on the surface, were unearthed and corrected. Experience clearly indicated that the handling and housing of casual railroad labor is a broad and considerably neglected field in which conditions have developed making generally for high turnover and low efficiency.

Work of Contract Gangs

Track work that the gangs were called upon to do included particularly every class of railroad maintenance work, a partial list being as follows:

- Applying tie plates
- Ballasting
- Bank widening
- Changing switches
- Cleaning out old ditches
- Cleaning up station grounds
- Constructing concrete culverts
- Constructing new passing tracks
- Constructing turntable foundations
- Constructing water-tank foundations and water tanks
- Ditching
- Driving foundation piles
- Fencing
- Fighting bush fires
- Grading
- Lining track
- Loading coal
- Loading and unloading cinders
- Loading and unloading new and second-hand steel rails
- Moving water tanks
- Opening and operating new gravel pit and constructing three miles of railroad from the main line
- Operating old gravel pits
- Painting
- Rail renewals
- Surfacing
- Tie renewals
- Tie loading

An equivalent of about 1,000 miles of single track railroad line was surfaced and generally overhauled. About 175 miles of new steel rails were laid and the old steel loaded and shipped out for branch line and other use. In addition, 325,000 cu. yd. of material were dug from pits and used for filling, ballasting and bank widening.

Jobs somewhat out of the ordinary were done, such as moving a water tank at Pine, Ont. This tank measured about 33 ft. high and 24 ft. in diameter, and weighed about 55 tons. After jacking it up, rollers were inserted and with heavy tackle and a hoisting engine the entire tank was moved on the tracks and 1,000 ft. west to its new location.

Much of this work was done in the long established railroad way. The chief difference was the introduction of the station-gang methods in tie renewals, ditching and culvert construction. Briefly these consisted in letting small sub-contracts, somewhat as grading and other work is let to station gangs on new construction. The general reason for this was that many men could be found who would not work for the day wages offered but who would work, and work hard, on a small contract of their own, netting slightly in excess of day wages.

Culvert work was done on a unit-price basis, with materials and tools furnished to the gang, which was outfitted and boarded similarly to the extra gangs. The members of the gang were usually known to each other and did the work on a share and share alike basis, one member being elected as foreman and handling reports and instructions. Ditching was done in the same way.

Tie renewal by contract was, it is thought, an entirely new method in maintenance work. The road was divided into sections depending on whether the ballast was hard, fair or easy to dig, and a price per tie renewed was established for each section by the district engineer. Gangs of six to ten men were made up and after choosing a section were given a contract, usually from 5,000 to 15,000 ties.

For the price per tie agreed upon, the old ties previously marked by the section foreman were dug out, the new tie placed, tamped and partly spiked and the old tie piled. Each section foreman was held responsible for the tie-contract work done on his section especially for the tamping, which was the part most easily skimped. The field superintendent and his assistant followed the work of each gang closely, but as the section foreman was primarily responsible for his track and was on it all the time, his supervision was usually effective.

Spiking was completed by the section gang. The price established per tie was considerably lower than the cost of ties put in by extra gangs, but owing to the greatly increased output per man per day(averaging around 50 per cent.) the tie gang could make better than day wages. Various allowances were made in the base price for long ties in the muskeg sections, switch ties, ties in centre tracks, spacing ties, where tie plates were installed and other lesser work than complete renewals. Some half million ties were put in by this method and a great variety of interesting points were developed.

Station gangs were paid on quantities determined by the field superintendent and representatives of the railroad, an advance being usually given them during the work and full payment promptly on completion of the work. As some other section of the line always looked better to the gang than where they were actually working, contracts were made for rather small quantities. When these were finished, the good gangs were given additional contracts on other sections, so that the same gang would often have four or five contracts in one season.

Payment of the extra gangs was made twice a month by check, payable at par at all banking points on the division, based on payrolls made up in the field office from time books turned in by each gang foreman or timekeeper. A travelling timekeeper checked up the gangs constantly. As a further precaution, paying off was rotated among several men. A special effort was made to pay promptly and accurately, as small but important items in maintaining good-will.

Cost records were kept of the usual major items, such as rail and tie renewals, surfacing and lining, ballasting and similar items, but under war and post-war conditions they gave no useful indication except as between the work of the different gangs and their handling by the gang foremen. Varying wage rates still further upset any standards of comparison. The chief criterion of the work was whether the program outlined in the spring was substantially completed in the autumn. The work assigned was fully completed each year. The wage rates paid were often less and never greater than those paid by the railways and others for similar work. Efficiency per man, while suffering in common with all other work in comparison with pre-war performance, was fully as high as, and in most respects higher than, that obtained by usual maintenance methods.

This system of doing the work by means of an organization outside the railroad was proposed originally by Grant Hall, vice-president of the Canadian Pacific Ry., and the work was done by the Sydney E. Junkins Co., Ltd., engineers and contractors, of Winnipeg and Vancouver. It was operated under the direction of J. C. Holden, district engineer, Canadian Pacific Ry., and by the three division superintendents on this part of the line; J. M. MacArthur, J. L. Jamieson and J. J. Horn.

Demand for Noiseless City Streets

That there is a growing demand for less noise in city streets is shown in the clamor among citizens and officials in New York and other eastern cities for a type of pavement that will reduce the noise of heavy motor traffic. Clifford Pinckney, city engineer of Manhattan, recently adopted the resilient asphaltic concrete base for Fifth Avenue with this end in view, claiming that this type of construction takes up the shock of impact. The Public School Principals' Association of Newark, N. J., has asked the city commission in that metropolis to adopt a paving construction program to extend over four years that will provide noiseless pavements in the vicinity of the schools. In voicing this attitude Newark takes the lead in this respect. The complaint in Newark is that the constant noise caused by heavy vehicles running over rough or rigid pavements prevents both teachers and pupils from carrying on their work effectively. It is the belief of the principals that the greater efficiency permitted by pavements that are smooth, resilient and noiseless will more than compensate for the additional cost.

April 5, 1922

Limitation of Heights of Buildings

The British Town Planning Institute Concludes, After Investigation, that High Buildings Have Serious Disadvantages—Lessons from the Experience of New York City

The Town Planning Institute (British) have been investigating the whole matter of heights of buildings with a view to giving an expression of opinion on the proposal to relax restrictions on the heights as at present administered in London, Eng. After a thorough study of the problem, the Institute has made a report which is published in "The Surveyor" and which is referred to here as being of general interest to town planners and others concerned with the heights of buildings.

Institute's Conclusions

The Town Planning Institute have arrived at the following general conclusions on the matter:—

(1) In considering restrictions on the height of buildings in London, full account should be taken of the climatic conditions there prevalent, of the winter height of the sun, the general intensity of light, the prevalence of mist, and the humidity of the atmosphere. They should also be considered in reference to the general width and direction of existing streets; to the policy that is likely to be adopted in the future in regard to the development of Greater London and its outer regional area; to the existing congestion of traffic, and to the practicability of providing increased transport facilities; and, in particular, regard should be had to the effect of any proposals on the general health and well-being of the occupants and users ot the buildings, and the convenience of the public generally.

(2) It is clear that an increase in the heights of buildings must add to any existing congestion of traffic and must throw a greater strain upon all public services. The volume both of pedestrian and vehicular traffic must be greater, and the capacity of drainage, water supply, and other conduits may need to be increased, as well as the public transport services, both for passengers and goods.

Inadequate Light and Circulation of Air

(3) Experience shows that it is extremely difficult to secure adequate circulation of air and sufficient light to the lower rooms where high buildings are adopted. It is common experience that in American cities a vastly greater proportion of rooms, both those in tenement buildings and those in business premises, require artificial light to be burned throughout the day than is the case in London. So important is this effect in America that frequently a high building standing alone and benefiting by the light over adjacent property is so seriously depreciated in value when the adjacent owners also increase the height of their buildings that the rent received falls to little more than enough to pay the local rates.

(4) It is by no means clear that the concentration of increasing volumes of retail trade in a few centralized establishments, or the concentration of general commerce on more restricted areas, which is the chief reason for the demand for increased height of buildings, is itself generally desirable in the public interest. In a city like New York, where the central area consists of an island surrounded by wide rivers, reasons of economic necessity may exist which are quite absent in the case of most towns, like London, where there is an unlimited area over which expansion can take place; and in view of the serious disadvantages arising from development by increased height, it is considered that some overwhelming public advantage and not merely a benefit to a limited number of prosperous businesses would need to be established to justify the relaxation of existing regulations, and the institute are of the opinion that no such general public advantage has been established.

(5) It is, of course, recognized that there may be situations so advantageously placed as regards open space about them, and so well served by existing roads and other services, that in these cases a reasonable increase of height might be permitted without public disadvantage. The institute are of opinion, however, that it is not possible to provide for anything further than the existing discretionary powers of the London County Council without incurring great danger, unless and until a comprehensive plan for dealing with building development and traffic problems throughout the whole of London is prepared; and that any such exceptional increase should then only be allowed in the case of specific sites fixed upon such a plan, agreed with owners, generally conforming with the requirements of comprehensive planning, and subject to special rating to compensate the public for the increased strain put by such buildings upon all public services.

Recommendations

The institute therefore recommend.—

(1) That no relaxation at present be made in the regulations dealing with the height of buildings.

(2) That so soon as the form of the future government of Greater London, now under consdieration, has been determined, a development plan of the whole of the area should be prepared, and zoning regulations on the lines of those recently enacted for the city of New York, but adapted to the special conditions prevailing in London, should be framed and given effect to. These regulations would deal with the height, density, use and character of buildings generally, and the zoning plan could provide for those exceptional sites, if any, where some increase of the general limit of height could wisely be permitted.

American Experience in Regard to High Buildings

Consideration has been given to the conditions in American towns where an unrestricted limitation as to height has obtained, and more particularly to the report which has recently been made in New York by a commission charged with the duty of investigating existing conditions and of drafting regulations as to restrictions. The committee consisted of representatives of the different boroughs, who were assisted by a technical staff. The final report of this commission was submitted on December 23, 1913, and, after holding a series of public hearings resulting in certain modifications, was finally approved in the year 1916.

In considering this report in its reference to the requirements of London, the Town Planning Institute have had in mind the peculiar conditions of New York as regards its wider streets and intenser light. The subsoil of London for the foundations of high buildings is in no way so suitable as is the solid rock upon which the city of New York rests, and not only is the question of cost of foundation one to be considered in the erection of such heavy buildings, but there is also the question of interfering with existing drainage schemes and disturbance to buildings on adjacent sites.

Even having regard to these natural advantages for the erection of high buildings in New York, the report referred to states that:—"There is an intimate and necessary relation between conservation of property values as here proposed, and the conservation of public health, safety and general welfare; throughout the city the areas in which values have been depressed by the invasion of inappropriate uses or lack of building control as to height, courts and open spaces, are the areas in which the worst conditions as to sanitation and safety prevail and where there is the greatest violation of the things essential to public comfort, convenience and order."

Insufficient Financial Return

Another point that is brought out in the report is that, after high buildings are erected in sufficient number so as to prevent adequate light and air being obtained for each building, they do not pay.

One of the elements which prevent high buildings from paying is the great cost of providing lifts and the great area of the most valuable floor space taken up by the lift service. It is claimed by authorities that it takes three times the lift capacity in car mileage for the second flight of ten storeys as for the first flight of ten storeys.

Proof of the business attitude towards high buildings as unremunerative is shown by the fact that the merchants of Fifth Avenue unanimously requested a restriction of height to one and a fourth the width of a street, the minimum height proposed to be fixed by the ordinance governing the matter.

In those cases where high buildings pay they have to borrow their light and air from adjacent property. So long as they are isolated they have a comparatively high rental value. But they destroy the light and air of the lower buildings surrounding them. One high building may depreciate the adjoining properties to a serious extent.

And it has been shown that the worst feature of high buildings is that while they prevent the free circulation of air, obstruct light and cause congestion, at the same time they do not pay; they cause great loss to the community in having to deal with the serious traffic problems they create and the strain they cause to public services. That a great increase in the congestion of traffic would follow an increase of height of buildings is clear to anyone who has been in an American city among the high business buildings when work commences in the morning, at the lunch hour, or during the time when the occupants are leaving work for home. As New York is on an island, London is much better off in its opportunities for developing laterally.

Population Guess Goes Astray

Toronto people who recall the visit of Mr. James Mansergh, the eminent consulting engineer of London, England, who made a special report on that city's water supply in 1896, will be interested in checking the estimate of the city's population made at the time of his visit. Mr. A. D. Creer of Vancouver, then on Mr. Mansergh's staff in London, made some special notes from the report. In it Mr. Mansergh made what he thought was most liberal provision for every possible development. Taking what he considered was an extremely optimistic view, his 1896 estimate was that in 1922 Toronto might possibly have 300,000 people, while the 350,000 mark would not be reached until 1930. It is noted that in 1910 Toronto reached the 350,000 population, just twenty years ahead of Mr. Mansergh's prognostication, which was thus proven to be as conservative as the eminent authority thought it was optimistic.

Trade Publications

The National Lime Association has issued "Lime Brief 251", which, summarizes completely all of the uses of lime and presents that summary on a functional basis, grouping together under various headings the uses that depend on the same chemical function. The publication covers the agricultural, chemical, and construction fields, and is arranged in such a way as to be useful to the lime producer, chemical manufacturers, and the educational institution. Included in the brief you will find a comprehensive chart giving a bird's-eye view of the entire subject.

* * *

"Science and Practice of Integral Waterproofing" issued by the Truscon Laboratories, Detroit, states the waterproofing problem and how to solve it in a very compact and convenient form. The first part of the pamphlet is devoted to the subject of "Why Concrete Requires Waterproofing", and the properties a waterproofing must possess to adapt it to this purpose. Included are specifications for waterproofing mass concrete, waterproofing general masonry by the cement plaster coat method and waterproofing cement stucco. Of special interest is the chapter devoted to the practical application of the waterproofed cement plaster coat. A copy of this publication is available free on application.

Trade Incorporations

Hochelaga Cement Company, with head office at Montreal, capital $3,000,000, to manufacture cement.

Strain & Emery, Limited, with head office at Windsor, capital $40,000, to carry on the business of general contractors.

Brookeville Granite Quarries of Canada, Limited with head office at Winnipeg, capital $600,000.

Sand and Gravel Products, Limited, with head office at Montreal, capital $100,000.

The Stephen Brick Co., Ltd., with head office at St. John, N. B., capital $99,000, to take over the business known as Lee's Brickyard.

Standard Stone Company, Limited, with head office at Windsor, capital $40,000, to prepare and manufacture stone and other building materials.

Fowler, Young & Holden Co. Ltd., with head office at Winnipeg, capital $60,000, to carry on the business of builders and contractors.

J. E. Lancaster Construction Co. Ltd., with head office at Montreal, capital $30,000, to carry on a general contracting and real estate business.

Construction Equipment Co. Ltd., with head office at Dorval, P. Q., capital $250,000, to deal in building equipment and machinery.

The King Engineering & Contracting Co. Ltd., with head office at Toronto, capital $100,000, to carry on the business of general contractors and engineers.

CONSTRUCTIONAL ACTIVITY

Period of March 29 to April 4, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Belleville, Ont.

City Council plan construction of pavement on 2 sts. J. G. Mill, Engr.

East Bolton, Que.

Town Council plan gravelling. W. E. Juby, secy.-treas., East Bolton.

Hamilton, Ont.

City Council plan construction of pavement on St. Catherine St. N. E. R. Gray, Engr.

Barton Twp. Council contemplate construction of sidewalks on Wentworth St., and resurfacing Brucedale Ave., A. G. E. Bryant, clerk, Court House, Hamilton.

City Council plan widening St. Catherine St. south from King. E. R. Gray, Engr.

Hull, Que.

City Council will construct extension to water main on Aylmer Rd. T. Lanctot, Engr.

Kamloops, B. C.

A. W. Jackson, City Clerk, will receive tenders until April 18th for construction of sewer to cost $35,000.

Kenzieville, N. S.

W. A. Hendry, Chief Engr., Prov. Gov't., Dep't. Pub. Highways, Hollis St., Halifax, will receive tenders until April 12th for roadwork. Accepted cheque for 10 per cent of tender recquired.

Kingsville, Ont.

W. G. Long, Town Clerk, has plans and will receive tenders until April 17th for paving to cost $110,000. Plans also with R. W. Code, Engr., 118 Chatham St., Windsor, Ont.

Kitchener, Ont.

Samuel Cassel, clerk Waterloo County Council, Court House, Kitchener, has plans and will receive tenders until April 10th for construction of concrete pavements in various parts of Waterloo County. Marked cheque for 5 per cent of tender required.

Leamington, Ont.

R. M. Selkirk, Town Clerk, has plans and will receive tenders, no closing date set, for construction of concrete pavement. Plans also with J. J. Newman, Engr., Davis Block, Windsor, Ont.

London, Ont.

City Council plan construction of sheet asphalt pavements at cost of $45,000 on Hamilton Rd. and Dundas St. E. H. A. Brazier, Engr.

City Council plan construction of tile sewers on Glasgow and Regina Sts. H. A. Brazier, Engr.

Moncton, N. B.

City Council plan construction of extension to watermains to cost $86,000. J. Edington, Engr.

Construction of concrete sidewalks at cost of $20,000 is planned by City Council. J. Edington, Engr.

Ottawa, Ont.

John Bingham, Chrm. Suburban Roads Cmsn., Thistle Bldg., will receive separate tenders until April 22nd for asphalt surface on roadway of Metcalfe Rd. and Richmond Rd. Plans with Alan K. Hay, Engr.

Stratford, Ont.

A. B. Manson, Engr., has plans and will receive tenders until April 8th for construction of 30,000 sq. yds pavement, concrete base; 22,000 lin. ft. curbs; 22,000 lin. ft. gutters.

J. D. Fisher, clerk North Easthope Twp. Council, R. R. 1, Stratford, will receive bulk and separate tenders until April 10th for drainage system.

Summerland, B. C.

Council plan construction of extensions and additions to water system to cost $15,000. F. J. Nixon, clerk.

By-law will be submitted to ratepayers authorizing construction of extension to municipal irrigation system to cost $55,000. F. J. Nixon, clerk.

Tillsonburg, Ont.

Town Council plan construction of macadam roadway on 4 streets A. E. Roynes, clerk.

Town council contemplate paving market square at cost of $8,000.

CONTRACTS AWARDED

London, Ont.

Contract for supply of a 2 stage 1½ in. discharge centrifugal pump for Public Utilities Cmsm. is awarded to the London Concrete Machinery Co. Ltd.

Montreal, Que.

Contract for electrical equipment required for electric pumping station costing $88,000 for City is awarded to Canadian Westinghouse Co. Ltd., 285 Beaver Hall Hill. Atlas Construction Co. Ltd., general contractors, 37 Belmont St.; A. Desbaillets, Engr., 50 Notre Dame St. E.

City Council awarded contract for cast iron pipe costing $40,000 to Canadian Iron Foundries Ltd., St. Maurice St., Three Rivers, Que.

St. Gregoire de Montmorency, Que.

Emile Cote, St. Gregoire de Montmorency, has general contract for construction of gravel road costing $25,000 from St. Mathieu to St. Gregoire de Mont morency for Prov. Gov.t'

Sandwich, Ont.

General contract for construction of pavements and sidewalks on Parkington Ave. for Town is awarded to Pettypieces Ltd., Box 38, Amherstburg, Ont. McColl & Patterson, Engrs., 7 Gas Bldg., Windsor.

Toronto, Ont.

Contract No. 613, being for construction of asphaltic concrete pavement, 4 miles, top of Ancaster Hill westerly towards Wentworth County Line, for Prov. Gov't., Dep't. Pub. Highways, is awarded to Roger Miller & Sons Ltd., Lumsden Bldg., Toronto. Contract No. 614, asphaltic concrete pavement from Winona westerly towards junction with Stoney creek, is placed with Johnson Bros., 43 Market St., Brantford.

Railroads, Bridges and Wharves

Ireland North, Que.

Plans are drawn for bridge for Town. I. E. Vallee, Engr., Pub. Works Dep't., Prov. Gov't., Quebec.

London, Ont.

Grand Trunk Rly. will rebuild bridge and abutments at cost of $10,000 near Huttons School, London Twp. Chas. Forrester, Supt., London.

Oak Lake, Man.

Construction of bridge costing $14,000 is contemplated by Municipality of Woodworth. W. V. Stevenson, secy.-treas., Harding P. O., Man.

Red Deer, Alta.

Canadian National Rlys. contemplate erection of station, freight sheds and stockyards at cost of $15,000.

CONTRACTS AWARDED

Belwood, Ont.

Contract for cement and retaining walls and abutments for steel bridge for Wellington County Council is awarded to Quinn & Wilson, Fergus, Ont.

Elie, Man.

General contract for construction of bridge for municipality of Cartier is awarded to Jos. Lavoie, St. Eustache, Man.

St. Mathieu, Que.

General contract for construction of concrete bridge for Town is awarded to J. A. Darris, St. Jerome, Que.

Toronto, Ont.

Contract for automatic sprinkler equipment required for Lansdowne car barns for Toronto Transportation Cmsn., Ryrie Bldg., is awarded to Grinnell Co., of Public Buildings, etc., Canada Ltd., 2440 Dundas W.

Public Buildings, Churches and Schools

Acme, Alta.

J. S. Meek will erect post office and telephone bldg.

Chatham, Ont.

J. C. Pennington & Boyde, architects, Bartlett Bldg., Windsor, have plans and will receive tenders until April 15th for erection of church to cost $100,000 for church of Blessed Sacrement.

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The Knickerbocker Theatre Disaster

No building disaster of recent years has caused such widespread consternation or induced such thorough and painstaking investigation as the collapse of a portion of the Knickerbocker theatre, Washington, D. C., on January 28 last, which resulted in a heavy toll of deaths and injuries. Immediately following the calamity, various authorities proceeded to study the wreckage in an endeavor to penetrate the mystery and determine a cause for the failure. In this issue we publish the report of one such investigating body— a committee of the Associated General Contractors of America—who, after carefully and intimately probing every detail of the disaster, have offered an explanation—the most plausible and the most probable explanation—of the collapse. In addition, the report endeavors to place the responsibility for the failure and recommends measures calculated to minimize the possibility of similar disasters in the future.

After a perusal of the report, as printed on another page, one cannot but wonder why the building has managed to stand the test of only the five years' time that it has been erected. Not one defect, but a dozen were unearthed in the investigation and any one of them appears almost bad enough to have alone caused disaster. Primarily, the collapse was due to unseating of one end of the main truss through a weakness of a gusset plate, but the failure of this detail and the resulting collapse culminated from many fatal weaknesses of design and construction.

Inadequate proportioning, bad details and lack of bracing characterize the whole roof structure; violations of the building code of the District of Columbia were flagrant, and, it seemed, almost wilful; inspection was neglected; responsibility shirked.. With this category of defects, is it any wonder that the structure reached an inglorious end? Indeed, by reason of the culmination of defects, failure was inevitable at some time, had it not occurred on January 28.

The question of responsibility naturally comes up and in this connection the A.G.C. report makes extended comment. Upon the architect and steel fabricator, obviously, fall the blame—upon the latter, who designed the steelwork, for the inadequacy of the design and upon the former for his failure to check and inspect the fabricator's design and for his own departure from safe practice and his violation of sound building practice and building legislation. Building inspection and supervision by a civic department cannot be expected to discover all the faults or remedy all the defects in a design and the architect, who fails to adequately perform his function, must be regarded as culpable. At the same time, the fabricator who substitutes, as in this instance, his own roof design for the architect's, which design contains serious violations of established practice, cannot escape his moral responsibility.

The prevention of similar disasters in the future should, of course, be one lesson to be learned from such disasters as the Knickerbocker theatre collapse. In this connection, several specific suggestions are made by the A.G.C. board. One of these is that, as a city's general funds are insufficient to provide thorough examination of plans and inspection of building work, building departments might make a charge for each permit, depending on the value of the structure, sufficient to pay for these services. Improvement of building codes is also recommended. Another suggestion is that registration of designers and constructors be made compulsory, while a scale of fees sufficient to enable architects and engineers to give competent service is also recommended.

A Good Construction Year in Prospect

On every side are indications that there will be a sound volume of new construction for the year 1922. The volume of contemplated new work reported in Canada during March, according to MacLean Building Reports, Limited, amounted to $23,773,100. Construction contracts awarded throughout the Dominion amounted to $13,465,000, compared with $10,718,300 in February, and $10,256,700 in March, 1921. Residential building accounted for 44.6% of the March total, and amounted to $5,930,800. Business buildings amounted to $5,267,200, or 39% of the total; industrial buildings, $260,000, or 1.9%; public works and utilities, $2,007,000, or 14.5%. A significant feature of the March construction record is the increase in business buildings over February.

During February the wholesale price index of 48 building materials advanced slightly and is now 89.2% above 1913 compared with a peak of 183.8% reached in May, 1920. Prices have now declined 51.6% from the high.

The construction industry has just passed through two extremely uncertain years, and 1922 ought to be hailed with satisfaction by those engaged in the industry, further comments MacLean Building Reports, Ltd., because of the fact that it holds promise of laying low the uncertainty of the past two years particularly, and in varying degree of the last seven years. The ending of this period of freaky markets and scattered demand points the way to a substantial resumption of activity throughout the industry. During the years of, and immediately following, the war, construction costs advanced tremendously, and much divergence in the cost bases of the various commodities and materials existed, but these costs are now approaching a new average level, higher than 1914 it is true, but evidently constituting a new normal on which business may be soundly transacted. This new normal will likely gradually recede during the next decade or more, and there will undoubtedly be frequent fluctuations during that period. While, as just said, the level of construction cost will probably recede for ten or more years, this recession will not be sufficiently great to pay prospective owners to postpone contemplated projects in anticipation of this reduction in costs. In fact, the price level to-day is economically sound, and it will pay owners to proceed with construction.

Taxes and Capital

Opponents of capital must learn that enactment of a high progressive surtax in the income tax law was like the victory of Pyrrhus. Beginning at $5000, the rate increases until it becomes confiscatory for large incomes. If a man invests in a productive enterprise and receives an income of $500,000, the government takes $303,190 of it. If he earns $1,000,000 he can retain only $336,810. Should he earn $2,000,000, the government would take $1,393,000, and leave him $608,100. Courts hold that capital is entitled to a fair return. For two seasons the Soviet took the peasants' grain from them, and at the third season they refused to plant except for their own needs. Now, Russia is starving. Take away the incentive of a return and capital will not be risked in industrial enterprise. That is why new promotions are falling off so rapidly. Capital is industry's life blood, but the surtax is a halter around its neck to strangle it.—Barron's Weekly.

National Highway Traffic Association's Annual Meeting

The annual meeting of the National Highway Traffic Association will be held at the Automobile Club of America, New York City, on Friday, May 12, 1922. The afternoon and evening sessions will be devoted to consideration of the reports of the following National Committees:

Afternoon Session

Report of National Committee on "Uniform Highway Signs", chairman, Elmer Thompson, secretary, Automobile Club of America.

Report of National Committee on "Traffic Capacity and Widths of Highways Outside of Municipalities", chairman, Herschel C. Smith, assistant professor of highway engineering and highway transport, University of Michigan.

Report of National Committee on "Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic", chairman, H. Eltinge Breed, consulting highway engineer, New York City.

Report of Executive Committee on "Highway Improvement Creed" of the National Traffic Association.

An informal dinner, at $1.50 per cover, will be served in the Grill Room of the Club at 6.00 p.m. The public is cordially invited to attend the dinner. Reservations for the dinner should be sent to secretary Elmer Thompson, 247 West 54th Street, New York City.

Evening Session

Report of National Committee on "Regulations Governing Speeds, Weights and Dimensions of Motor Trucks and Trailers", chairman, George H. Pride, president, Heavy Haulage Company of New York City.

Report of National Committee on "License Fees and Motor Vehicle Taxation", chairman, Henry G. Shirley, roads and sanitary engineer, Baltimore County Roads and Sewerage Department.

Report of National Committee on "Highway Transport Franchises", chairman, F. W. Fenn, Secretary, National Motor Truck Committee, National Automobile Chamber of Commerce.

Report of National Committee on "Highway Transport Clearing Houses", chairman, Tom Snyder, secretary, National Association of Commercial Haulers, Indianapolis.

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
March, 1922	$ 7,553,800	$ 4,154,600	$ 210,100	$1,546,500	$13,465,000
March, 1921	5,774,300	1,882,700	426,000	2,173,700	10,256,700
March, 1920	9,351,300	4,097,200	754,300	7,075,300	21,278,100
March, 1919	5,464,900	1,434,600	1,173,500	1,447,900	9,520,900
3 months, 1922	20,679,900	6,741,400	668,600	4,486,000	32,575,900
3 months, 1921	14,044,700	14,251,900	827,600	7,721,000	36,845,200
3 months, 1920	28,901,800	13,914,700	1,888,000	10,976,200	55,680,700
3 months, 1919	9,498,800	15,828,600	2,820,700	4,106,900	32,255,000

According to Classifications or Types	Residential	Business	Industrial	Engineering	Total
March, 1922	$ 5,930,800	$ 5,267,200	$ 260,000	$2,007,000	$13,465,000
March, 1921	4,581,100	4,567,100	408,800	699,700	10,256,700
March, 1920	5,058,800	8,821,800	4,324,400	3,073,100	21,278,100
March, 1919	2,199,200	3,824,500	2,072,800	1,424,400	9,520,900
3 months, 1922	12,343,700	9,590,400	1,158,500	9,483,300	32,575,900
3 months, 1921	8,793,600	17,902,500	1,871,800	8,277,300	36,845,200
3 months, 1920	8,869,200	18,702,300	21,219,300	6,889,900	55,680,700
3 months, 1919	4,297,300	6,594,400	10,389,200	10,974,100	32,255,000

Regrading of Main Street at Canadian National Terminals, Vancouver

An Extensive Project Involving Removal of Bascule Bridge, Construction of a Sea Wall With Several Unusual Features, and the Building of a Large Storm Overflow Drain

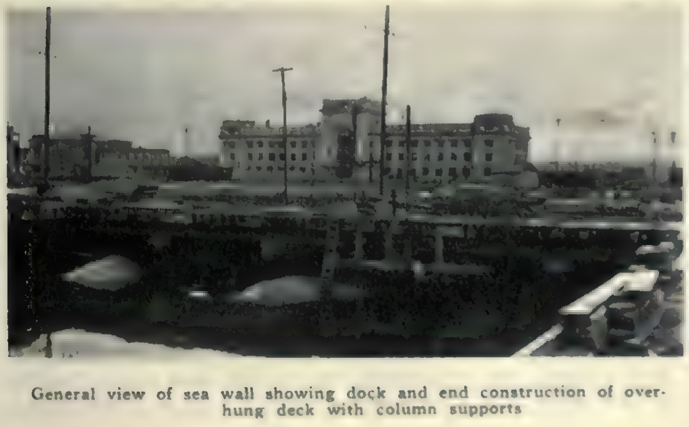
By **J. B. HOLDCROFT, A.M.E.I.C.**
Contract Record Correspondent

A number of extensive projects are in the hands of the Board of Works of the city of Vancouver, B. C. at the present time, one of the most important being the regrading of that portion of Main Street affected by the construction of the Canadian National station and terminal yards on the reclaimed area of False Creek. This work includes the removal of a bascule bridge span, with its piers and approaches, which formerly crossed the neck of False Creek on the line of Main Street, which is one of the principal arteries out of the city on the direct route to New Westminster and the Fraser Valley. A sea-wall has been partially constructed to the west of the former bridge site and forms the western boundary of the reclaimed area. This wall includes in its length two small docks which are intended to afford landing facilities to the large fleet of launches and mosquito craft generally which ply on the waters of False Creek, a busy stretch of water which runs through a highly industrialized section of the city.

The wall proper has some unusual features of design, owing to the character of the foundation, which is on silt and sand, and to the necessity of providing suffcient stability to withstand the thrust and overturning stresses of the fill behind the wall, which when deposited was practically in a liquid condition, being pumped into the area by suction dredge. The wall itself is of the ordinary counterfort type, is one foot thick, with counterforts 1′ 6″ in thickness, spaced 9′ 0″ apart. Projecting outwards from the wall is a deck 8″ in thickness supported near the outer edge by concrete columns 4′ 6″ in diameter, which are spaced 25′ apart. These were cast in situ and support a reinforced concrete girder 1′ 10″ by 4′ 0″ and joists partly cantilevered, 1′ 4″ by 2′ 6″ in section, supporting the deck itself. This arrangement forms a remarkably stable structure for a situation such as this where heavy stresses somewhat difficult of determination were to be expected in combination with a not very satisfactory foundation. This wall, as well as other portions of the work, was commenced a number of years ago but for various reasons was delayed and it is only during the last year that work on the whole scheme has been resumed and is now being pushed to an early completion. The engineers' estimate of the cost of completing the sea-wall is about $31.000.

Another major item in the scheme is the first section of a large storm water overflow which, with its future extensions, roughly follows the line of the former deepest channel in the reclaimed area, and is designed to take care of 630 cubic feet of water per second at a grade of 0.1%. The portion built is 600 feet in length and consists of two cells, 6′ 6″ by 9′ 0″, with a 14″ plenum wall between. This work is now practically complete and the cost as nearly as can be estimated at present is nearly $91,000.00. Over 10,000 cubic yards of excavation were included in the job, and something like 2,000 cubic yards of reinforced concrete. A feature of the design on which the designers lay special stress is the provision of a cover of at least three inches of concrete over the steel at all points, while in the invert four inches of cover has been required. This is regarded as essential in construction of this nature where the concrete is exposed to the action of sewage, industrial wastes and sea-water of the unclean nature likely to be found in a land locked channel such as this discharges into.

Pile supports were required under the whole area of the drain. Careful designing was required at the junction of the drain with the sea-wall before mentioned, and a good deal of intricate form work was required, it being necessary to flare the section out into a bell mouth. This necessity was due to the lack of head room between the invert level and the bottom of the deck framing at the sea-wall. On the other hand, it was considered inadvisable to maintain the increased width necessary at this point throughout



General view of sea wall showing dock and end construction of overhung deck with column supports

Clam shell backfilling trench over completed storm water drain

Reinforcement in place and concrete being poured for storm sewer in connection with Main St. regrading, Vancouver, B.C.

the length of the drain with a uniform height, as very heavy loading is anticipated over the section from railway traffic. So with a view to making the roof span as short as possible the height was increased to nine feet and a plenum wall introduced, leaving the effective span as short as 6′ 6″ for the most of the length.

With the completion of these portions of the scheme, work will immediately proceed on the filling of the area to grade, which will be done by suction dredge using material obtained in deepening the channel and tnrning basin outside the sea-wall. $59,000.00 is allowed for this portion of the work, which will then be completed by paving the entire area between the line of Main Street with cement or asphalt, while the land lying on the east of Main Street and fronting on the Canadian National station building will be converted into a public park.

Light Design and Poor Concrete Cause Collapse of Concrete Bridge

Three Arches and Two Piers of an Almost Completed Bridge at Palm Beach, Fla., Fail Under Conditions that Emphasize the Need for Careful Supervision and Erection

In the collapse of three arches and the two intermediate piers of the almost completed arch bridge between Palm Beach and West Palm Beach, Florida, we are again reminded of the ever-present necessity for careful supervision of the design, and erection of concrete structures. In this particular case it seems that although the design was strong enough to suit the requirements of highway traffic, it afforded scant leeway for contingencies during erection and the quality of the concrete together with defective pier base construction which was brought to light by diving, seems to indicate poor erection methods or supervision.

The bridge when completed was to consist of thirteen concrete arches of 63 ft. clear span, with a 174 ft. steel swing span which was arch number 6, numbering from the west end. This steel span and arches numbers seven to thirteen inclusive and the easterly approach was to be built first and opened on Dec. 1st. This period was extended two weeks and further delays put off the opening until Jan. 1. About noon on Dec. 29th., however, spans 8 and 9 collapsed and during the night span 7 and pier 8 went out leaving the abutment pier 7 badly listed toward the collapsed portion, the steel span remaining intact.

The arches are reinforced concrete barrel arches with earth fill, 12 inches thick at the crown and 24 inches thick at the skewbacks. All the reinforcement was deformed, and the piers contained no vertical rods, and there was, apparently, no bond between the skewbacks and the piers.

Doubtful Nature of the Foundation Strata

The piers were constructed steel-pile cofferdams, the material within being pumped out with a 6-inch centrifugal pump. The rock was cleaned off and according to the contractor's superintendent, two holes, 6 feet deep, were drilled into the rock without going through it. The concrete was placed under water by tremie and was not continuous in the larger piers. The rock encountered was a soft coral formation into which sheet piling can often be driven and sometimes even pine piles can be driven through it.

At the time of collapse, the centering for the arches was all in place although the concrete was from 26 days up to two months old. The centering was built on the piles of the old bridge upon which were placed pony bents supporting the arch logging. Wedges were used in a few cases to take up the slack.

An inspection after the collapse showed that pier 8 is still in place with the top a few feet under water. Pier 9 has entirely disappeared, the cause of this being at present, undetermined. The dowel rods between skewbacks and arch barrels pulled out clean and the concrete has the appearance of mortar showing scant use of poor large aggregate. Most of it could be crushed in the fingers when first removed.

A general summary of the probable causes of the collapse follows:—

1. The unusually light type of design, due, no doubt, to a doubtful form of economy.
2. The poor quality of the concrete at critical points due to the absence of a proper amount of large aggregate.
3. The doubtful nature of the foundation rock.
4. The method of building up the piers and the absence of vertical reinforcement.
5. The method of placing the sand spandrel filling which was taken from the bottom of the river. This was done hastily and, as it was started at one end and continued towards the other end, may have resulted in unsymmetrical loads being imposed on the arches. These strains, however, should have been taken care of by the factor of safety.

It might be interesting to note here that a study of concrete multiple arches by full-sized tests has been proposed to the Engineering Foundation by A. C. Janni. The object of the study is to confirm or correct the theory of stresses in such elastically continuous arch spans. It is understood that the above failure stimulated the proposal. The Engineering Foundation has referred the subject to its advisory committee and the co-operation of the American Society of Civil Engineers will probably be asked for.

Building Exhibition in Vancouver Stimulates Construction

Second Annual Show Was a Remarkable Success and Helped to Stir Up Public Interest in Building—Staged Under the Auspices of the General Contractors' & Master Builders' Association

Results of the second building exhibition held in Vancouver, B. C., are such as to encourage both promoters and exhibitors in the view that such an annual event must be considered as a fixture in future. The exhibition this year was under the auspices of the General Contractors' and Master Builders' Association of Vancouver. Its scope was wider than purely a building Show—it was made to include also house decoration and house furnishing, and in that connection, the exhibit of the model electric home put on by the Vancouver Electric Service League, and participated in by all branches of the electrical industry, was one the most attractive features of the whole exhibition.

There was a preliminary campaign undertaken by the Contractors' and Builders' Association, which served a double purpose. It paved the way for an awakened interest in building on the part of the general public and it furnished publicity for the coming building exhibition, assuring large attendance. This campaign was in the form of a series of conferences arranged by Col. E. J. Ryan, of the Contractors' & Builders' Association, with various labor unions and with the associations representing the material supply houses, the object of the conferences being to secure substantial reductions in wage scales from the unions and in material prices from the supply men. A very considerable degree of success attended these efforts, and the attendant publicity in the daily press served to remove the feeling of uncertainty which has been the cause of a great deal of delay in starting building operations. Many people have been putting off home-building because of lack of assurance as to the reduction of costs and their present stability.

Arranging to Stage Exhibition

Through co-operating with the B. C. Manufacturers' Association, the building and house furnishings exhibition was located in the Cassidy Building, a large four storey block in the business district of the city. A management and advisory committee, comprising leading members of the Contractors' & Builders' Association, and other prominent business men had executive oversight of the arrangements, while active management was left in the hands of Col. Ryan, who was assisted by Col. J. F. Keen as honorary secretary. A very large and representative exhibit of all classes of building material was assembled. Exhibitors of heating and plumbing plant and equipment were also prominently represented, while the electrical industry as a whole united in arranging and equipping a model of an electric home. This included kitchen, dining room and bed-room, showing interiors in which were fitted every sort of electric convenience. Demonstrators were supplied by the staffs of the individual concerns represented in the Electric Service League, and by a relay system, constant attendance of men qualified to explain the working of each appliance was assured.

Most assuredly the number of people in daily attendance at the Building Exhibition was enhanced by the direct incentive of "taking a chance" on securing a $5,000 bungalow which was advertised to be given away free. Every paid admission carried with it the privilege of dropping a numbered coupon into a box. Each evening of the two weeks during which the exhibition was open, twelve coupons were drawn from the box, and the numbers announced. The entire number of coupons thus drawn daily were held until the closing evening of the show, Saturday, March 25, when the final drawing was made and the winner of the capital prize was announced. A model of the bungalow was shown in the big display windows on the ground floor of the building and served to draw the attention of many who passed in the street. On the occasion of the final drawing the entire ground floor of the large building was packed with visitors who were keenly interested in the outcome.

The experience of the recent building exhibition as to the increase of attendance as the period advanced was similar to that of 1921, when the closing date found the attendance just beginning to grow. This year the period was made two weeks instead of one, in light of the previous year's experience, and the results justified the decision. Naturally the cost of maintaining an exhibit, once it is installed, is not a much greater item for two weeks than for one, and in the longer period the exhibitors found more satisfactory results. Individual exhibitors discussing the immediate returns from their work, stated that they had found every encouragement from the effort, which they considered had been well worth while making. After the close of the Exhibition Col. E. J. Ryan stated that while the financial results would show a small deficit, from every other angle the exhibition had been a distinct success. "Many of the exhibitors," said Col. Ryan, "volunteered the information that sales made directly in conjunction with their exhibit had been most satisfactory. From many contractors, members of our association, encouraging reports have been coming in that general building is going ahead. The season now opening up gives promise of seeing building operations on a very large scale." He expressed the view that the success attending the second annual building exhibition had made it sure that it would be repeated next year.

Commendable Action of Contracting Equipment Firm

Mussen's Ltd., Dealers in Contractors' Supplies, After Being in Liquidation for Seven Years, Pay Creditors 100 Cents on the Dollar

A procedure which cannot be too highly commended and one which must, undoubtedly, tend to increase the confidence between the distributor and his customer, is exemplified in the attitude of Mussen's Limited toward their customers through the seven-year period since they went into voluntary liquidation in 1915. At that time, Mr. W. H. C. Mussen stated his confidence in the future of his company and pledged himself to see that all the creditors received payment to the last cent. This promise was fulfilled on March 31 last, when checks covering the final 10 per cent. dividend completed the payment of all liabilities.

Mussen's Limited is engaged in the sale of railway, mining and contractors' and municipal supplies and is thoroughly well known throughout the respective fields covered by these products. In 1915 they were faced with difficulties of collections and of profitably disposing of the heavy stock on hand. The stock was of a nature that could not be readily turned into money under conditions of depression in construction work and the action taken was regarded as offering the greatest possible protection to the creditors. It is worthy of note that no re-organization of the company was sought and apparently no thought was entertained other than to protect the creditors to the last cent.

It is gratifying to know that through this seven-year period, Mussen's Limited have received the support of the manufacturing firms whom they represent—with only one or two exceptions—and that they have been approached by a number of other manufacturers to carry their lines, thus showing a confidence which straightforward dealing only engenders. The firm's branches in Toronto, Winnipeg and Montreal are now firmly re-established. The heads of departments have all been retained, so that the efficiency of the organization will not suffer in any way.

The creditors of Mussen's Limited are to be congratulated on the happy outcome of this matter, but we cannot but feel that Mr. Mussen himself is to be even more congratulated on the honorable, businesslike course he has pursued throughout. It is such ideals as this that make for the stability of Canada's industrial life.

Mr. Mussen, the president of the firm, has been for years a prominent figure in the business life of Montreal. At the age of 16 he accepted a minor position with the old established firm of Cooper, Fairman & Co., later known as James Cooper, Montreal, dealers in railway supplies, and beginning at the bottom, he mastered every detail of the business, finally becoming travelling salesman. In 1901 Mr. Mussen decided to embark in business on his own account, and established the firm of W. H. C. Mussen & Co. Five years later the name of the company was changed to Mussens Limited, of which Mr. Mussen became president and general manager. Mr. Mussen has many interests outside of his business, being especially prominent in the club and athletic life of Montreal. In this connection he has numerous club affiliations.

Arbitration Concerning Excavation of Mount Royal Hotel

An arbitration has been held, extending over the past two weeks, concerning the excavation and foundation of the Mount Royal Hotel, Montreal, the Geo. tion of the Mount Royal Hotel, Montreal, the George J. Atwell Co., being the claimants and the Thompson Starrett Company the defendants. The Atwell Company was represented by Brown, Montgomery and McMichael, and the Thompson Starrett Company by Meredith, Holden & Shaughnessy. The arbitrators were Mr. C. E. Fraser, contractor, Mr. Henry Holgate, consulting engineer, and Mr. A. D. Swan, consulting engineer, the latter being chairman of the board. We understand the claimants asked to be paid between $100,000 and $200,000 over and above the contract amount, owing to conditions being entirely different from what they understood them to be. The decision of the arbitrators is expected to be made known at an early date.

"The Indian Empire as a Market for Canadian Products", by H. R. Pousette, Director, Commercial Intelligence Service, has just been published by the Department of Trade & Commerce, Ottawa. This interesting booklet contains much valuable information for the Canadian manufacturer relative to the market for various products, as well as tables of imports into India during that period between 1919-1921. Information in connection with the geographical position of the country's larger cities, their population, industries, etc., is also contained in this booklet. Copies may be obtained from the Department of Trade & Commerce, Ottawa.

Dwight P. Robinson & Co., engineers and constructors, New York and Montreal, are issuing a house organ entitled "The News", the first number of which appeared in March. It is a newsy sheet, recording the activities of the Dwight P. Robinson Co.'s forces and the progress of their various jobs.

Construction Developments During the Month of March

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, March, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	2	$ 30,500	2	$ 155,000					4	$ 185,500
Churches	4	74,500	3	226,500					7	301,000
Factories	11	193,000	1	50,000					13	251,000
Garages	5	49,000	5	81,800					10	133,800
Hospitals	2	125,000					1	$10,000	3	135,000
Hotels and Clubs	2	20,000	1	6,000					3	26,000
Office Buildings	4	196,000	8	1,061,700			1	18,000	13	1,275,700
Public Buildings	1	5,000					1	16,000	2	21,000
Residences	741	3,694,000	325	1,483,300	2	$ 8,000	1	4,000	1069	5,189,300
Schools	8	548,000	6	593,000	1	115,000	1	5,600	16	1,261,600
Stores	80	849,300	16	223,000	4	7,000	2	3,500	102	1,082,800
Theatres									1	15,000
Warehouses	3	485,000							3	485,000
Total Buildings	863	$6,269,300	367	$3,883,300	7	$130,000	7	$57,100	1246	$10,362,700
Bridges	1	$ 6,000	2	$ 35,000					3	$ 41,000
Dams and Wharves	1	27,600	1	10,000					2	37,600
Sewers and Watermains	4	109,900	3	52,300					7	162,200
Roads and Streets	3	128,000	3	94,000					6	222,000
General Engineering	15	1,013,000	3	80,000					18	1,093,000
Grand Total	887	$7,553,800	379	$4,154,600	7	$130,000	7	$57,100	1282	$11,918,500

Construction Contracts Awarded in Western Canada, March, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Churches	1	$ 1,000	1	$ 4,000					2	$ 5,000
Factories	2	9,000							2	9,000
Garages	2	6,000	1	6,000			1	$ 25,000	1	37,000
Hotels and Clubs	2	3,500							2	3,500
Office Buildings	1	6,000	1	7,000	2	11,000	2	306,500	6	330,500
Public Buildings			1	5,000	1	3,700			2	8,700
Residences	103	377,300	20	60,800	9	25,300	27	92,600	159	556,000
Schools	1	28,000	2	5,400					3	33,400
Stores	12	58,800	2	8,000	2	22,000	4	15,300	20	104,100
Warehouses	1	1,100	2	7,000					3	8,100
Total Buildings	125	$490,700	30	$103,200	14	$62,000	34	$439,400	203	$1,095,300
Bridges	2	$178,000							2	$ 178,000
Sewers and Watermains	1	6,500							1	6,500
Roads and Streets			1	$ 12,000					1	12,000
General Engineering	1	25,000	1	218,000	2	11,700			4	254,700
Grand Total	129	$700,200	32	$333,200	16	$73,700	34	$439,400	211	$1,516,500

Contemplated New Construction Work in Canada, March, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	12	$ 467,000	5	$600,000	1	$ 8,000	4	$ 188,000	22	$1,263,000
Churches	15	480,000	9	233,700	2	40,000	3	48,000	29	801,700
Factories	14	942,500	6	145,000			9	197,000	29	1,284,500
Garages	11	165,000	3	80,000	1	10,000	4	116,000	19	371,000
Hospitals	4	185,000			2	50,000	3	142,000	9	377,000
Hotels and Clubs	15	294,500	2	154,300	3	105,000	9	216,000	29	769,800
Office Buildings	7	565,000	4	1,580,000	1	40,000	7	365,000	19	2,550,000
Public Buildings	8	410,000					11	423,000	19	833,000
Residences	380	2,516,000	135	1,051,500	13	76,000	85	465,600	613	4,109,100
Schools	38	1,780,000	26	1,470,500	3	61,000	39	521,100	106	3,832,600
Stores	30	578,500	8	1,598,000	1	15,000	13	336,500	52	2,528,000
Theatres	3	300,000	1	50,000	1	50,000			5	400,000
Warehouses	3	74,000	3	50,000	1	10,000	2	50,000	9	184,000
Total Buildings	540	$8,757,500	202	$7,013,000	29	$465,000	189	$3,068,200	960	$19,303,700
Bridges	6	$ 76,500	15	$ 483,000	1	$30,000	4	$ 152,500	26	$ 742,000
Sewers and Watermains	21	352,500	11	101,900	1	15,000	3	95,000	36	564,400
Roads and Streets	28	730,000	15	771,000	1	50,000	4	195,000	48	1,746,000
General Engineering	9	575,000	2	118,000	1	50,000	10	674,000	22	1,417,000
Grand Total	604	$10,491,500	245	$8,186,900	33	$610,000	210	$4,184,700	1092	$23,773,100

What Caused the Collapse of the Knickerbocker Theatre?

The Investigating Committee Appointed by the Associated General Contractors of America Attributes the Collapse of the Roof to Twisting Failure of Truss End as a Result of Defective Design—Plans and Specifications Incomplete and Inspection Inadequate—Number of Unforeseen Items Indicates Incompetence or Indifference

No building disaster within recent years has so shocked the public or caused such concentrated attention and investigation as the collapse on January 28 of the roof of the Knickerbocker theatre, Washington, D. C., which resulted in the death of nearly a hundred persons. Such calamities are regrettable, to say the least, but much more, they are in ninety-nine cases out of a hundred, unnecessary and avoidable. Laxity in some quarters is generally responsible and in this specific instance, an abundant looseness of methods seems to have been evident.

Investigations into the cause of the disaster were instituted immediately upon its occurrence but none of these has been more thoroughly or painstakingly carried out than that fostered by the Associated General Contractors of America. The Contract Record, realizing that contractors and engineers should have as much information as possible regarding the Knickerbocker calamity, shortly after the disaster, made arrangements with the A. G. C. to publish this report as soon as it had been completed. This is now done herewith.

The committee appointed by the A. G. C. to investigate the collapse were Rudolph P. Miller, consulting engineer, formerly superintendent of the building department, New York; James Baird, vice-president, George A. Fuller Company, and Guy Mason, of Mason and Spauling, attorneys, Washington, D. C. W. P. Christie, Research Engineer of the Associated General Contractors, served as secretary and technical assistant to the committee.

Pursuant to permission granted by Commissioner Keller of the District of Columbia, the committee has made an investigation of the plans and specifications for the theatre, the roof loads stresses in steel members as constructed, their position and condition after collapse, the condition of the walls and all testimony given under oath at the coroner's investigation. This work has entailed numerous inspections of the building and the wreckage, together with measurements, sketches and photographs for showing conditions attending the collapse. A careful study has also been made of the various failure theories offered at the coroner's inquest or presented through the press.

From the facts and circumstances revealed by the investigation, it has been the purpose of the committee primarily to derive information which can be utilized in eliminating as far as possible such disasters in the future. As the ordinary and usual investigations, made and reported while the public mind is still affected by the shock of a disaster, rarely bring about constructive action beneficial to the public, the investigation committee was requested: First, to ascertain the fact; secondly, to assist in determining the responsibility; and thirdly, to recommend any measures that should be taken to minimize the possibility of such disasters.

Part 1

Cause of the Collapse

The collapse of the Knickerbocker Theatre roof is attributed by this committee to unseating of the north end of the main truss, primarily through failure of the northernmost top gusset plate of that truss and the bottom chord where it rested on the Columbia Road wall. This half-inch gusset plate, which furnished the only lateral stiffness of a heavy upper chord, buckled to the west, and the lower chord where it rested on the wall, without reinforcement for bearing stresses and eccentricity, was crushed and tilted under a combination of tension, compression and torsion, or twisting stress. This action, which is later explained in more detail, culminated from many weaknesses of design, the most vital of which were as follows:

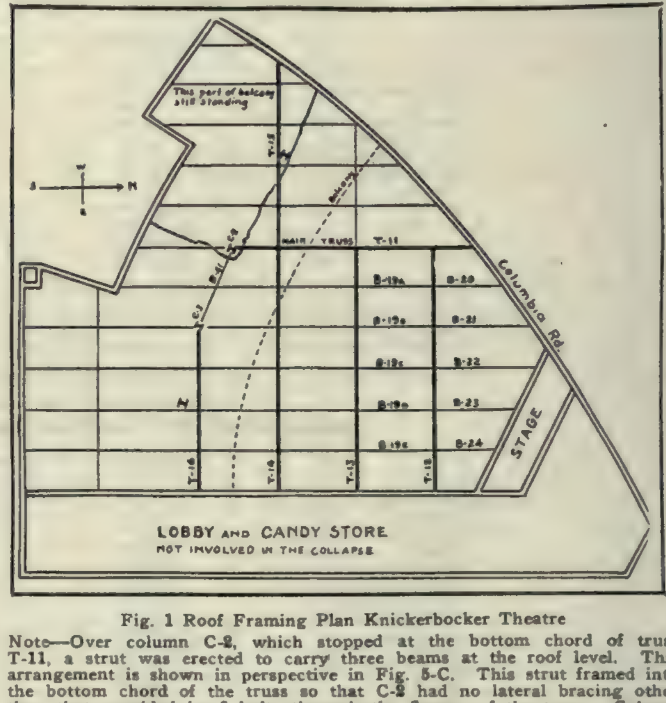


Fig. 1 Roof Framing Plan Knickerbocker Theatre

Note—Over column C-2, which stopped at the bottom chord of truss T-11, a strut was erected to carry three beams at the roof level. This arrangement is shown in perspective in Fig. 5-C. This strut framed into the bottom chord of the truss so that C-2 had no lateral bracing other than that provided by 6 bolts through the flanges of the truss. Column C-3 extened up to the roof. The other two columns shown stopped at the balcony floor.

First: The over-stressing of steel roof members which produced excessive downward deflection of the main truss. This over-stressing resulted from (a) using loads for the design which were greatly exceeded by the actual load, (b) from reducing the height of the main truss, as originally designed, and (c) from failing to splice the top and bottom moment plates which were placed on the truss in short sections, and did not butt together.

Second: The designing of the main truss bearing so that the center of stresses fell on the edge of the wall, thus producing eccentricity and tension in the bearing.

Third: The failure to anchor trusses to the walls, especially over a short skew bearing at the wall support of the main truss. This design failed to provide for the additional outward thrust against the wall which developed at such a bearing when the truss is deflected.

Fourth: The failure to reinforce the bottom chord of the main truss where it bore on the wall or even to connect the channels of this chord where they extended beyond the gusset plate to form the bearing. Thus, no adequate provision was made in the bottom chord for three additional stresses acting upon it, over and above the load which it carried as a member of the truss. These stresses were: (a) the full load of the north end of the truss, (b) a twisting caused by the skew bearing, and (c) the tension caused by the center of stresses falling on the edge of the bearing instead of at the center.

Fifth: The omission of a cover plate at the junction of the top chord and batter post of the main truss, thus limiting the stiffness of the truss to that of a half-inch gusset plate at that point.

Sixth: The placing of a heavy concentrated load on a high and relatively thin hollow tile wall, neither adequately braced nor integrally bonded and further weakened by many openings and chases.

Seventh: Lack of adequate diagonal or other bracing throughout the steel structure and especially around the two columns carrying roof trusses, thus providing insufficient rigidity to the structure as a whole.

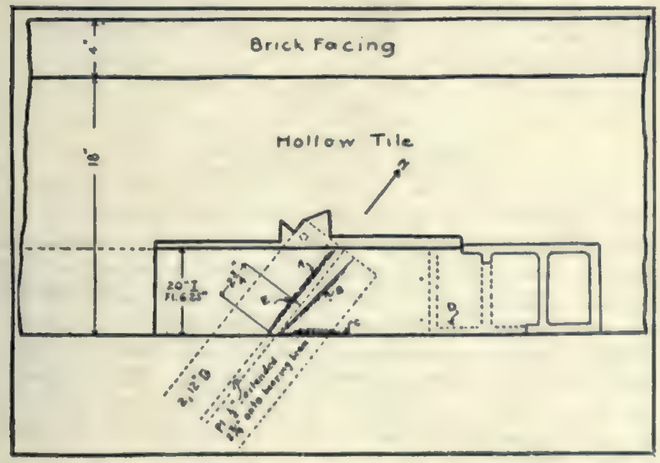


Fig 2.— Sketch of north bearing of main truss showing position of truss on the bearing. A and B indicate the bearing marks made by adjacent edges of the lower chord channels, showing that these edges spread apart while the truss was on its seat. C indicates abrasion under the east flange of the chord. D indicates tile broken by the end of the truss and by a vertical strut framed on to the extension of the lower chord. E shows the north edge of the gusset plate.

Note.—The two 12-inch channels forming the bottom chord of the main truss had but eight inches of bearing on the west wall measured along the centre of the chord. They also overran the gusset plate 5⅛ inches. Thus the two channels were practically independent of each other as far as bearing strength is concerned. This arrangement also placed the centre of stress on the edge of the wall, producing an eccentricity of about four inches. The two channels with their ends free, therefore, were subjected not only to the end load of about 110,000 pounds but also to the bending stress caused by this eccentricity. The web of the west channel at the end was still straight after the collapse, while that of the east channel was rolled up as shown in Fig. 4. Fig. 3 shows the probable positions of these webs prior to collapse as indicated by the bearing marks. Fig. 4 shows their condition after the collapse.

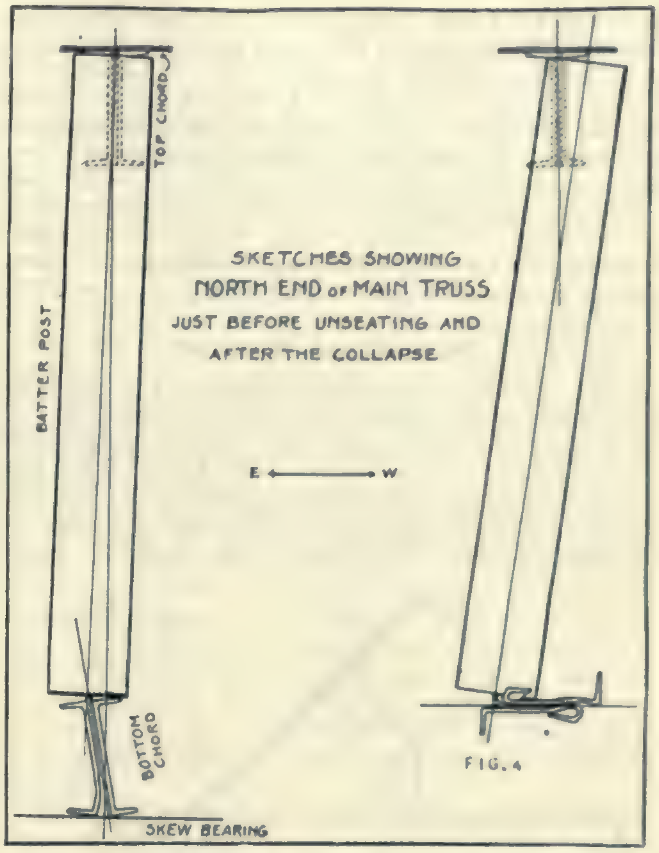

TOP CHORD
BATTER POST
SKETCHES SHOWING NORTH END OF MAIN TRUSS JUST BEFORE UNSEATING AND AFTER THE COLLAPSE
E
W
BOTTOM CHORD
SKEW BEARING
FIG. 4

Fig. 3 Fig. 4

Fig. 3—Shows the probable condition of the lower chord prior to unseating of the truss as indicated by the bearing marks shown in Fig. 2

Fig. 4—Shows the approximate condition of batter post and chords when the members were separated by cutting torches during the rescue work.

Weaknesses Concentrated

One or possibly all of these weaknesses might have been present in the building without causing collapse—had their effects been distributed to various parts of the structure; but unfortunately it occurred that these effects combined and concentrated at the north end of the main truss. The culmination of this condition in a final collapse is herewith summarized:

As already mentioned, the actual roof load greatly exceeded the design load; the main truss was reduced about 9 inches in depth from the original design, and its moment plates were neither butted together nor spliced. These factors all produced excessive downward deflection of that truss. This deflection, acting on the skew bearing, created a thrust at the Columbia Road wall, which tended to push the wall outwardly and to twist the bottom chord of the truss. Either of these movements, occurring in but a small degree, was capable of unseating the truss, as its bearing perpendicular to the wall was only 6 inches and that parallel to the bottom chord 8 inches. (See Fig. 2)

To resist this twisting force the only stiffness provided was that of a half-inch gusset plate and of the bottom chord in the first panel. The batter post could contribute nothing as its rigidity was in turn limited by a half-inch gusset at its upper end. (See Fig. 8.) Thus the bottom chord from the twisting force alone, was probably in a hazardous condition. Furthermore, the two 12-inch channels forming this member extended beyond the gusset plate with their webs unsupported, forming an eccentric bearing. (See Figs.

5 and 7.) These webs therefore took practically the full bearing load of the truss and the stress from its eccentric bearing as well as the twisting force. Under such a combination of stresses failure in the bottom chord, or bearing, was at some time almost inevitable. A condition existed that would have been dangerous with a thoroughly adequate wall, and when with this was combined a thin wall badly cut up by openings, a condition must have existed which awaited but an additional load, a measure of vibration or fatigue of the over-stressed metal to result in a collapse.

Overload and Vibration

The additional load and probably the vibration and fatigue were present when the roof gave way. A snow load of some twelve or thirteen pounds per square foot, or about 16 per cent of the dead load (computed from precipitation recorded by the U.S. Weather Bureau), exclusive of possible drifting, and the heaviest since completion of the building, was on the roof. Vibration from passing street cars had been noted on the structure and was doubtless accentuated at times by a double eight-foot ventilating fan carried on the roof. The snow load which increased the dead load at the north end of the main truss some 15,000 pounds was, so to speak, the last straw in destroying equilibrium at the support. It undoubtedly provided the additional stress necessary either to buckle and twist the member resting on this bearing, or to buckle the gusset plate above. Which action took place first it is impossible to state, but that both actions did occur is shown by the distorted steel members and marks on the north bearing. (See Figs. 2, 3 and 4.)

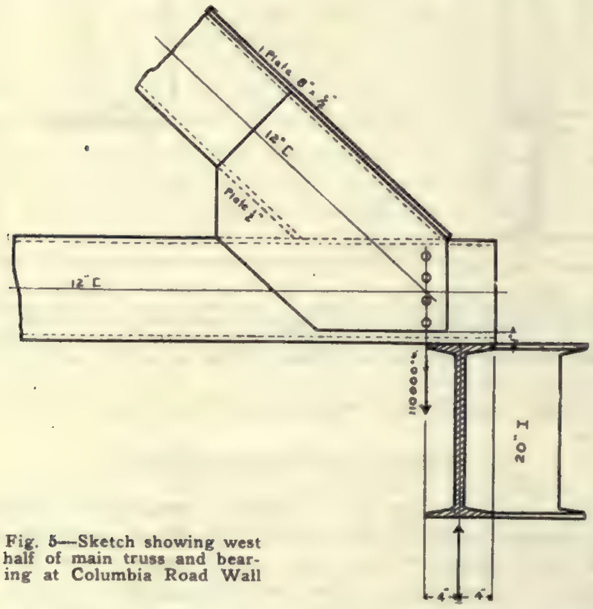


Fig. 5—Sketch showing west half of main truss and bearing at Columbia Road Wall

Note—The arrangement of this bearing caused an eccentricity of about four inches so that the centre of stresses fell on the edge of the wall which is flush with the edge of the bearing beam. Marks on the bearing surface of the I-beam, indicating that the bottom of the east channel (not shown here) moved away from the west one before unseating, are plainly visible. It is this east channel that was rolled up at the end, the west one showing no distortion at the end (see Fig. 2.)

When the web of the east channel of the bottom chord buckled, the top of that member (not the whole truss) was twisted eastward, thus unlining the batter post, and moving the center of stresses off the bearing. With the bottom chord in this condition only the lateral stiffness of the wall could prevent the truss from sliding off. This stiffness the wall did not have. It was pushed outward about 5 inches—sufficient to break its bond with the stage wall, to break the stage wall itself, and to allow the truss to drop.

Whether the upper gusset plate or the bottom chord channel failed first is immaterial, as either action would have brought about the other and would have thrown the batter post out of line. Once this member was displaced, collapse readily followed. Unlining, or distortion, of the batter post is a condition that easily results in failure of even a well-built truss.

No failure of an auxiliary truss was essential to unseat the main truss, and no failure of a beam, as they were actually erected, is believed to have been capable of causing a failure in the auxiliary truss T-12. In no member of the steel, except the bottom chord mentioned, has any evidence of failure between supports and before falling been found. Collapse through a succession of preliminary failures seems highly improbable in view of the difficulty experienced in efforts to cause collapse when demolishing structures.

It is common knowledge to men of experience in the wrecking of old buildings that a sudden collapse or giving away of any large portion of the structure can be affected only by destroying a major supporting member. The only member of this nature existing in that area at which eye witnesses say the failure began was the north end of the main truss, and the suddenness with which this truss collapsed seems to preclude the possibility of it having been unseated by the failure of a minor member of the steel framing.

Various reports on the Knickerbocker have assigned the collapse to one or another preliminary failure, while at least two have located the initial action at the north end of the main truss. For the purpose of bringing out more clearly the actual and probable facts, the more comprehensive theories advanced are reviewed in Part II of the report. There also is given a more detailed discussion of conditions present in the structure, together with sketches, evidence, descriptions and further reasons for believing that failure did not originate in any auxiliary member of the structure.

Part II

History of Construction

The construction of the Knickerbocker Theater was begun late in 1916 and completed in the fall of 1917. The original steel work consisted of beams and girders, following the general layout as constructed, but the difficulty of securing certain materials during the war period prompted the fabricator to submit a design of his own involving a system of trusses which could be built from material on hand. This design was approved by the building department but, according to testimony at the coroner's jury, never checked by the architect.

During the course of construction a strut not originally contemplated was added to furnish bracing between the two columns supporting roof loads, and at the instance of the contractor, a reinforced concrete girdle was built into the west wall, at about its center and extending practically throughout its length.

The roof slab, which has been considered an important factor in various analyses of the collapse, was poured about the first of June, 1917.

Description of Building

The shape of the building was approximately that of a half segment of a circle, with the arc running parallel to Columbia Road and one side paralleling 18th Street. Part of the building at the intersection of these two walls was occupied by the theater stage and a store and that portion facing 18th Street by the lobby. Neither that part of the building comprising the store nor that comprising the lobby was involved in the collapse. (See Fig.1.)

The curved wall, which is the only one concerned in the roof failure, varied from 13 to 22 inches in thickness, but the main body of it was 18 inches thick, and composed of two thicknesses of 8-inch hollow tile with a space of about two inches between. On the street side of the wall was a facing of brick, stone or stucco approximately four inches thick, which under the Washington Code could not be considered as an integral part of the wall. The average height is slightly over 40 feet above the sidewalk.

The steel work as constructed consisted of a main truss 6 feet 6 inches deep which rested with one end on the curved wall and the other on a column. This truss, running north and south, carried certain beams and four auxiliary trusses, three from the east wall and one from the west. Another truss with certain beams rested with one end on the east wall and the other on a second and the only column extending to the roof. The upper flanges of all beams and of the top chords of trusses, excepting the two batter posts of the main truss were imbedded in the concrete roof slab.

The roof slab having an average span of about 10 feet, was three inches thick and reinforced with No. 6 wire mesh, three inches on center. The ceiling was suspended partly from the steel members and partly from the roof slab. On top of the slab was a layer of cinder concrete varying from three to nine inches to furnish drainage slope; and upon this was a four-ply composition roofing covered with slag. The actual weight of trusses, beams, slabs and covering was approximately 75 pounds per square foot.

At about the center of the roof was a double eight foot ventilating fan with motor and housing weighing probably two tons. Further details of the structure are shown by the accompanying sketches and photographs.

Description of Collapse

The roof of the theater collapsed about nine P.M. on January 28, 1922, while between four and five hundred persons, an unusually small audience, were in the building. At the time of the collapse a heavy snow storm was in progress; in fact, the heaviest since the building was constructed and which placed upon the roof a depth of snow of approximately two feet, exclusive of likely drifting.

The roof fell bodily into the pit carrying with it approximately the eastern two-thirds of the balcony. The column under the main truss which did not extend to the roof was pushed out from under the truss without being injured. This column rested on one of the balcony columns which did not fail and was joined to it by bolting through two splice plates. The only column extending to the roof was buckled by the truss framing into it and the load of this column fell upon the balcony buckling the column directly beneath and one other column supporting the balcony.

The main truss was practically undistorted outside the north panel where the lower chord which formed a bearing on the west wall was buckled and twisted about 90 degrees. The gusset plate above this chord was buckled and torn while the batter post and top chords were thus thrown out of line about four inches; otherwise, none of the members of the main or auxiliary trusses show indication of failure before falling.

The Columbia Road wall was found five inches out of plumb at the main bearing, shattered at the southwest corner where an auxiliary truss rested upon it, and cracked practically through its height in three other places. These three cracks show in the brick and stone facing and it has not yet been ascertained whether they extend also through the tile. This wall pulled away from the stage wall about two inches at the top and pulled that wall apart, about halfway between the stage and the Columbia Road wall.

The main truss apparently fell free of the Columbia Road wall as no scratching is evident; but the four auxiliary trusses on the east side did scar the east wall with their bearing ends during the collapse. The flanges of the bearing beams which carried the wall end of these trusses were bent downward, with the exception of the northernmost which is practically straight, and the southernmost which carried a truss independent of the main truss.

The slab was badly shattered by the fall but in the southwest corner it remained suspended without rupturing over a span of about 20 feet.

Eye witnesses testify that a crack was seen to open in the plaster up near the left of the stage and that an instant later the roof fell. A witness who sat in the balcony near the column of the main truss testified that there was no noise nor disturbance in that vicinity before the crack at the stage was noticed or before the collapse occurred. The testimony given shows rather conclusively that the initial movement, regardless of its cause, occurred in the vicinity of the west side of the stage.

Defects of Design

It is difficult to draw a distinct line between what constitutes design and what constitutes the detailed work of the designing service necessary to make it complete. Both elements, however, are a part of the whole field of design and are therefore treated to-

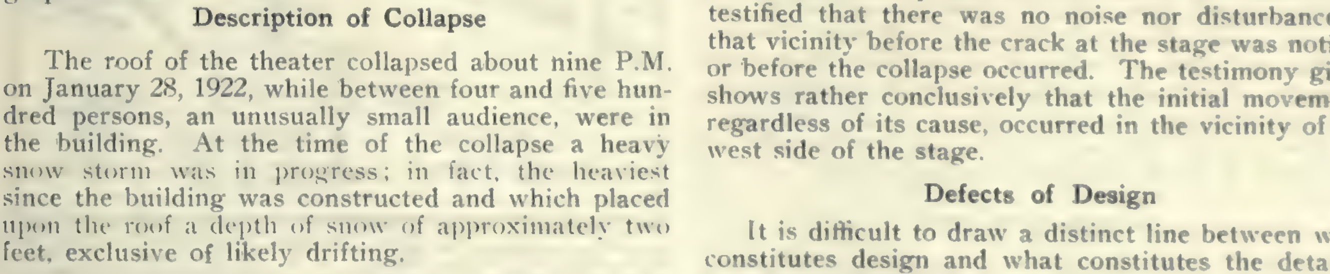


Fig. 5A—Stress Lines of Main Truss—The solid lines represent the stress lines of the main truss, as shown by the fabricator's stress sheet. The dotted lines represent the stress lines of the fabricated truss, as determined from measurements taken after the collapse

gether in this section. These defects are as follows:

A. Walls

(1) The Columbia Road wall of the structure was not a safe wall for the heavy concentrated load placed upon it. It was approximately 40 feet high, 18 inches thick and not integrally bonded. About 45 per cent. of its length was occupied by openings. Even a solid brick wall of this height and length would have required a minimum thickness of at least two feet to accord with good practice.

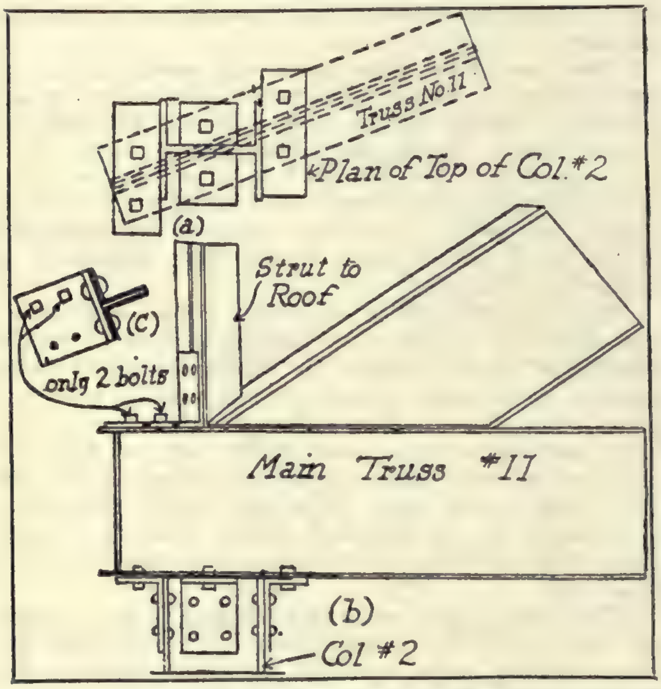


Fig. 5B.—Arrangement of South End of Main Truss—The vertical strut shown carried three beams as indicated in Fig. 5C. This strut bent over on the side where the two bolts were missing, breaking the two which were in place. Had the missing bolts been in place, they would not have resisted this action.

(2) A skew bearing was used on this wall to carry the heavy concentrated load of the main truss and no provision for anchorage was made. Such a bearing should have special consideration in its design to guard against the tendency to slide sidewise. The actual bearing surface was only six inches wide normal to the wall, and only a small movement of the wall or truss was necessary to cause unseating. (See Fig. 2.) The omission of anchorage was an infraction of the Washington Building Code.

B. Structural Steel

(1) The main column, C-2, supporting the main truss, was in itself, given no lateral bracing, and no bearing plate. Its ends were not milled and at its connection with the column below was merely bolted through two splice plates which enabled it to carry practically no stress except a simple vertical load. This condition was greatly responsible for the completeness of the collapse which occurred in the vicinity of the balcony.

(2) Sufficient lateral bracing to give the structure stiffness as a whole was not provided. This was a contributing cause to the collapse. (See Fig. 5C.)

(3) No reinforcement of the bottom chord was provided to take care of bearing stresses and of the canting action caused by the skew. This was one of the main causes of the collapse. The bottom chord shows conclusive evidence of failure through bearing.

(4) The center of stresses of the lower chord and batter post at the north end of the main truss came on the edge of the wall bearing, giving about four inches of eccentricity. This caused additional stress in the chord which was not provided for.

(5) The channel of the bottom chord extended about five and one-half inches beyond the gusset plate at the north main truss bearing without a filler between the webs, so that their bearing strength was greatly reduced. These webs were thus dangerously overstressed and one of them shows every indication of having failed before the truss dropped.

(6) Moment plates on the top and bottom of the main truss were put in in sections and neither spliced nor butted together. They were thus unable to transmit the stress from one panel to the other, which forced the top and bottom chord channels to carry the full stress, this contributing greatly to the deflection of the truss.

(7) No cover plate was placed over the batter post and top chord of the main truss. This limited the lateral stiffness of the compression chord to that of a half inch gusset plate. This gusset plate failed at some time during the course of the collapse and is one of the most critical weaknesses in the steel design.

(8) Moment plates of the main truss were broken at panel points which were not supported laterally, thus decreasing the lateral stiffness of the truss. The top chord of the truss buckled at these points, probably during the collapse.

(9) The distance between stress lines in the stress diagram was used as the outside dimensions of the truss which reduced the effective depth of the main truss about nine inches. (See Fig. 5A.) This also was a factor in increasing the deflection of that truss. Also the center of stresses of the diagonals did not pass through the center of stress at the panel point.

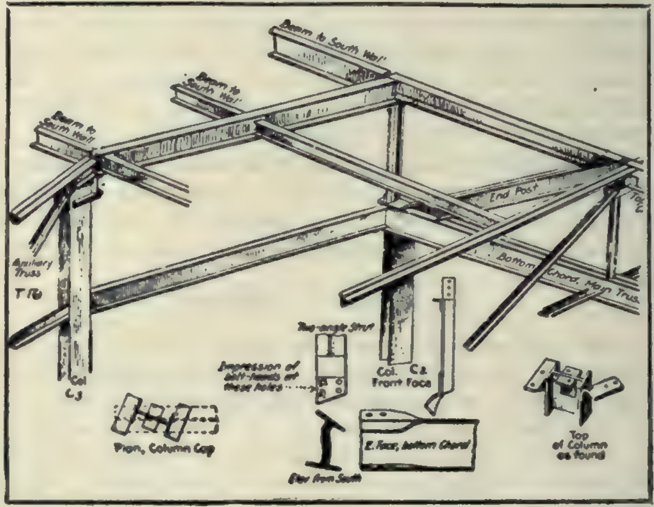


Fig. 5C.—Arrangement of Steel at Columns C2 and C3—The lower strut between the two columns was not in the original design. This sketch shows the flimsiness of the design at column C2, which was displaced from the truss without distortion.

C. Roof Slab and Loads

(1) The roof slab was too thin for the load and length of span used, and while not a primary factor in the collapse, was a distinct departure from good practice and capable of producing a local failure.

(2) The stress sheet shows no provision made for

the load or vibration of the double eight foot ventilating fan carried on the roof.

(3) The actual dead load of the roof as designed and constructed was about one-third more than the load which appears to have been used in computing stresses. This added greatly to the deflection of the main truss which was an important factor in the collapse.

Defects of Construction

Defects of construction consist of poor workmanship, use of faulty materials and variations from the plans, and specifications and building regulations. If the contractor furnishes the material and builds the structure as the architect described it, then the structure's weaknesses are not considered as defects of construction for which the constructor was responsible. Defects of this nature found in the Knickerbocker Theatre were as follows:

(1) The bearing plate of beam B-24 was so placed that this beam had only a partial bearing at the wall. This defect, however, apparently had no influence upon the collapse, as it was not unseated until the truss fell.

(2) The strut over column C-2 where it fastened to the top of the bottom chord of the main truss, was provided with four holes for anchorage to that member. The chord itself, however, was provided with but two holes, thus two bolts on one side were omitted. These holes should have been bored and the bolts inserted. This strut, however, bent over against the side which was not bolted and the absence of these two bolts cannot be assigned any responsibility for the collapse. See Fig. 5B.)

(3) A number of light colored hollow tile were used, which were considered by some to be of inferior quality, but evidence before the coroner indicates that tests of these tile have shown them to be of the usual commercial strength.

(4) The Columbia Road wall and the stage wall were not bonded for a distance of six or seven feet at the top. Such bond as existed, however, was sufficient to break the stage wall about half way between the stage opening and the Columbia Road wall so that this defect is not regarded as a contributing cause of the collapse.

Review of Other Analyses of Collapse

A number of theories seeking to explain the initial collapse of the roof have been advanced in the press and at the coroner's inquest. The evidence upon which they are based has been carefully studied by the committee which has checked practically every point mentioned with the evidence existing at the structure. It has found that some of these theories have not mentioned a number of important facts. (See Fig. 1.)

Theory of Joint Committee of Army and Navy Engineers

The report of the Army and Navy Engineers attributes the roof collapse primarily to failure of the bearing under beam 21. Presumably the expansion and contraction of the roof slab moved the Columbia Road wall and reduced the area of this beam's support. The bearing then failed through crushing of the tile allowing beam 21 to drop and crushing the roof slab to pull beam 22 sideways toward Columbia Road until it also left its support. When these two beams fell they released beams 19b and 19c by breaking the bolts which fastened these two sets of beams at their union with truss T-12. T-12 buckled, then pulling off the main truss T-11 from its Columbia Road support, thus causing the entire roof to drop.

The condition of the steel members and wall bearings which this Committee has found at the site of the building, is incompatible with the action outlined by the above theory. That such action could not have taken place is believed to be shown by the following facts:

1. At wall bearing 22 the cement which was spilled on the bearing plate at the west side of the beam was not disturbed and a piece of the tile projecting from the wall could not have remained in place as it now does had this beam moved westward. Shortly after the accident there were distinct scratches on the bearing plates showing that beam 22 moved practically straight south.

2. Where each pair of beams, for example, B-20 and B-19a, framed into truss T-12 the flange of the top chord of that truss was buckled up sharply on both sides. Beams B-19d and B-23 are still hanging from the truss. On the underneath side of the top chord of the truss are distinct dents that could have been made only by a scissor action from each pair of beams as the truss preceded them in its fall.

3. If beam 21 had failed first, the top chord of truss T-12 should naturally have buckled first at that point, but the top chord is not buckled between beams 20 and 22.

4. The top chord of T-12 where beam 22 joins it is buckled and torn but the fracture is a clear tension failure and shows clearly the effect of the scissor action mentioned above, indicating that the fracture occured after flange of the upper chord was pinched by beams 22 and 19-C.

5. Both beams at each connection were fastened with four bolts at their junction with truss T-12, and even if beams 21 and 22 had dropped first they could not have exerted a turning effect on T-12. The turning effect would be counter-balanced. Moreover, the top chord of this truss was imbedded in the concrete roof slab, which would greatly resist buckling before the fall.

6. If beams 21 and 22 had dropped from their wall supports and broken their truss connections, the first sign of collapse should have been the appearance of their north ends as they broke through the ceiling. This, according to eyewitnesses, did not take place.

7. That the Columbia Road wall could have been moved outward by expansion seems improbable as the roof slab was poured about the 1st of June and at initial set probably possessed its largest volume. Also the roof was covered with cinder concrete and 4-ply composition roofing, and it is doubtful that any material change of temperature or volume ever occurred.

Theory of Colonel P. M. Anderson of the War Department

This analysis is practically the same as that of the Army and Navy Engineers except that failure is attributed to the roof slab which presumably pulled beams 21 and 22 towards each other and off their support. (See Fig. 1.)

This analysis is not supported by evidence in the wreckage. Pieces of slab examined directly under this point showed extra reinforcing of three-eighths inch corrugated rods which indicated that this was probably one of the strongest portions of the roof slab. The parting of this slab could not have pulled these beams toward each other, and since in the southeast corner of the building a slab of 20 feet or more is still holding together unsupported, this action appears unlikely. The same reasoning applies to this theory from the point where the two beams were unseated, as applies to the preceding theory.

Theory of Mr. C. M. Condron, Consulting Engineer, Chicago, Ill.

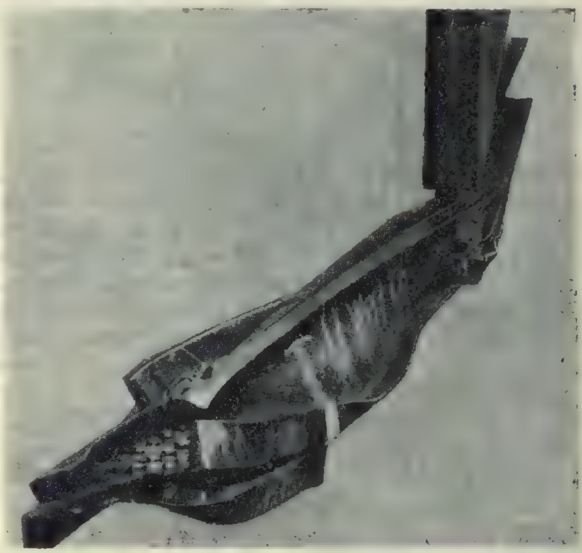
This theory places the immediate cause of failure in the column C-2 at the rear of the theater. Presumably, the column failed through over-loading. This allowed the south end of the main truss to drop pulling the north end from the wall and producing a general collapse.

This theory appears entirely plausible but it is not borne out by evidence of the structure nor by evidence given at the coroner's inquest.

1. Though this column was undoubtedly weak and overstressed it underwent no distortion throughout the collapse. It is still perfectly straight and coated with about half the plaster that was originally on it.
2. Had this column failed and pulled T-11 from its bearing, the last point of contact of this truss with the bearing would have been the northwest corner of the flange of the bottom chord. A load of some 55 tons would have been placed upon this corner. That this did not occur is evidenced by the fact that this corner, even now, is not bent. (See Fig. 4.)
3. An eyewitness sitting in the balcony not far from this column who saw a crack open up at the left of the stage, noticed no noise or disturbance in the vicinity of the balcony before the crack appeared.

Theory of Mr. R. W. Geare

This theory places the origin of collapse at the top chord of truss T-12 where beam 22 is attached; presumably, a weakness in the steel caused the truss to buckle at this point pushing the beams on the north side into the stage wall, this allowing T-12 to pull T-11 from its bearing. This action is believed impossible from the fact that the stage wall shows no evi-



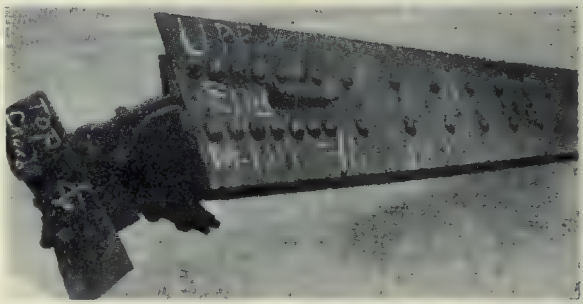


Fig. 7—This photograph of the north end section of the bottom chord of truss T-11 shows the effect of a twisting stress, which, combined with the bearing stress, turned the bottom chord off of its bearing on the Columbia Road wall.

Fig. 8—This photograph shows the omission of a cover plate at the upper end of the north batter post of the main truss, and the manner in which the gusset plate buckled toward the west.

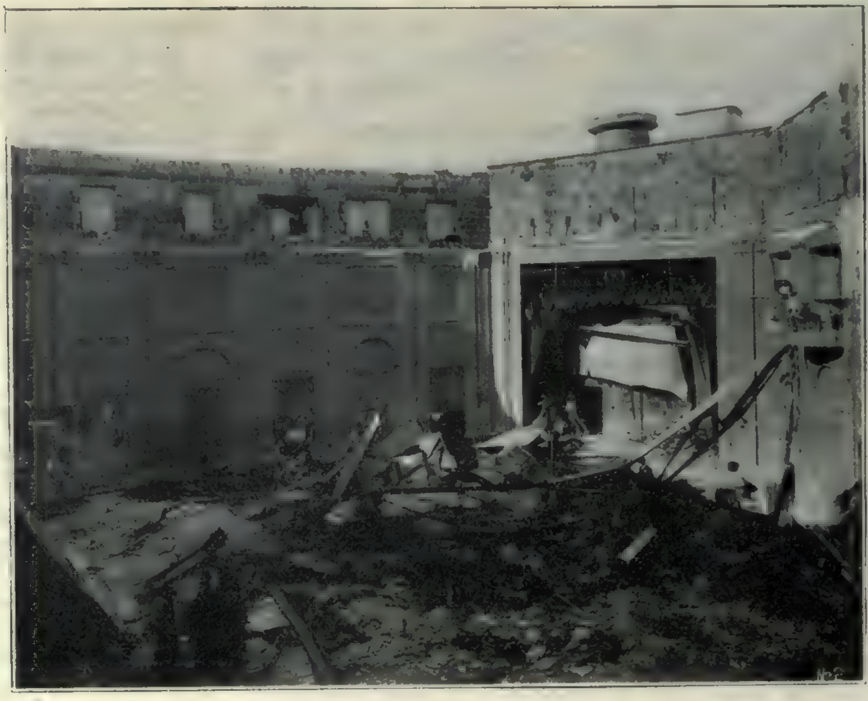


Fig. 6—Interior of the Knickerbocker Theatre, Washington, D.C. after collapse of the roof, showing the walls remaining intact.

dence of the beam having punched through the hollow tile at the beam ends. The imprint of the beam ends in concrete that was spilled around them during construction is still intact and shows that no thrust occurred there. Moreover, the fracture in the flange of the top chord of T-12 is a clean tension break in a compression member and shows the effect of the scissor action of the beams on each side, which could not have occurred after the flange tore. The fracture mentioned appears to have been caused by falling of the truss and not by any buckling while on its bearing.

Theory of Ernest B. Ruebsam, formerly in Charge of Structural Designs for the Supervising Architect

This theory places the origin of failure in the gusset plate at the north end of the truss at the junction of the top chord and batter post. Presumably, the truss buckled at this point where the lateral stiffness was only that of the gusset plate. This caused the top of the batter post to move to the west, thus unlining truss T-11 and pulling T-12 from its wall bearing on the east wall.

This theory undoubtedly strikes at one of the weakest points of the structure and is in part, concurred with by this Committee. However, the action relative to unseating T-12 appears to have been unlikely. The east end of this beam did not fall clear to the bottom but caught on an opening at the second floor lobby. Had the east end of this truss fallen first and taken this position, it would have undoubtedly pushed the end of the main truss over to the Columbia Road wall. That this action did not occur is evidenced by the fact that the north end of the main truss did not touch the Columbia Road wall in its fall.

In this theory, however, are pointed out the most important weaknesses of the structure, such as excessive deflection of the main truss, lack of splicing moment plates, overloading of trusses, and general instability of the main truss at the bearing, all of which were contributing causes of failure. Failure of the gusset plate mentioned and distortion of the lower chord of the main truss actually occurred in the collapse, but it is difficult to say how much occurred in the fall itself.

Analysis of the Engineering News Record

This analysis attributes the initial failure to the unseating of the main bearing at the Columbia Road wall. It points out the weakness which contributed to this action and denies the possibility of failure having originated in any auxiliary member of the steel. In these and practically all other essential points the report of this Committee concurs.

Responsibility

In the erection of a building, particularly a building to be used as a public gathering place, all persons engaged in designing and erecting the structure, like the operators of public utilities, are jointly and severally responsible for its safety. This responsibility is entailed by the fact that their operations are intimately connected with the public welfare.

The highest degree of responsibility undoubtedly rests upon the architect, as it is upon him that the owner relies for a properly constructed building; but every other agency involved in the project has an individual responsibility for the character of the work. This individual responsibility may be somewhat limited by practical limitations of service, but, nevertheless, it is constantly present. Each agency presuming to render construction service, from the contractor to the fabricator, is obligated to communicate to the architect any knowledge that may bear on the safety of the structure. If any agency finds that, in its judgment, changes should be made in the plans to insure structural safety, it is the duty of that agency to notify the architect. The co-operation of the local building authorities should also be constantly sought.

It is essential that a clear distinction be made between design, design details and construction before responsibility can be determined. For this reason, a brief statement of what comprises the service and duty of each agency is given in the following sections:

1. Municipal Approval and Inspection

Municipal approval and inspection are a service rendered to the public to insure it that buldings shall be erected in conformity with zoning, occupancy, health, building code and other requirements laid down by public authority. Its scope may include, in some instances, investigation into features of design, but to completely check the design of each structure erected would exceed the working capacity of a municipal building department. It would require a staff of experts almost equal to the combined forces of private designers and would entail an expense and duplication of work too great for a municipality to bear. Field inspection also is limited by a like consideration of expense. Inspectors are obliged to cover an extended area of the city and to divide their time between a great number of buildings. Strict detailed field inspection would require an inspector constantly on each building, as a great amount of work may be executed in his absence. So far, this has been an excellence of service which the building department's appropriation will not permit. Therefore, to ascertain whether an employee of the department is culpable because weaknesses of design or construction are incorporated in a structure, it is necessary to determine whether it was reasonably possible for him, considering the magnitude of his duties, to detect those weaknesses.

The function of the building inspector's force is analogous to that of the police force, and it can be held responsible for infraction of other laws. In neither case should the full responsibility for the result of such infractions be shifted to the guardians of public authority. In the case of the Knickerbocker, responsibility for the disaster cannot justly be laid to employees in the department of building inspection, except in so far as it may be shown that an official or employee has failed in his duty of apprehending any violation of the building code. But even if this is finally shown to have occurred, it would in no sense relieve the other agencies of construction from their respective responsibilities. Such a course would not only be equivalent to charging a policeman with responsibility for a murder in his precinct, but it would set a dangerous precedent in removing from architects, engineers and contractors the responsibility for their actions.

2. Design and Supervision

Design and supervision constitute the service rendered by an architect, or an architectural firm, to a client who is the owner. Unless otherwise agreed between these two parties, the former is obligated to execute a safe design; to supply adequate plans and specifications for estimating the cost and erecting the building, and to furnish supervision that will insure its erection in accordance with these instruments. This service may not include the drafting of detailed working drawings which are sometimes made by the contractor or a manufacturer, but it does include checking and approving such drawings regardless of their origin.

To insure that the owner's building shall be erected as specified, the architect should place on the work an inspector or superintendent. This supervision serves not only to safeguard the interests of the owner, but also, in public buildings, to insure the safety of the public. Even when the architect is confident of the constructor's skill and responsibility the failure to provide this supervision is a dangerous practice which cannot be too strongly condemned; and it is especially dangerous when adequate detail drawings and specifications are lacking. The contractor is not a designer, does not know the stresses which determine the design, and should have adequate supervision and consultation to execute the work as it is planned.

If any parts of the building, built in accordance with plans and specifications as either drawn or accepted by the architect, are found to be inadequate or improper, then he cannot avoid responsibility for the condition of such parts. Neither can he disclaim responsibility for violation of the plans and specifications, if laxity in supervision has made such violation possible; though in the latter case the agent of the violation should be held fully responsible for his own acts.

In so far as any portions of the Knickerbocker Theatre, which were built as shown by the plans and specifications, are found to be a departure from the dictates of safe practice, to that extent the design and supervision are responsible. In considering the matter, however, cognizance should be taken of an unusual circumstance involving design of the steel roof members. The fabricator, on account of difficulty in securing certain material, submitted an alternate design of his own, and this, it appears, was approved by the building department and accepted by the architect upon their approval. Adoption of this design obviously entailed responsibility to the owner for its safety, but, on the other hand, did not in any sense release the fabricator from responsibility for departures from safe practice.

As the details of structural steel fabrication are practically standardized, the responsible fabricators may usually be relied upon to execute a safe design for any given conditions. Many of them maintain thoroughly expert designers whose system of detailing and checking practically precludes an error. For this reason individual architects have placed in them a great degree of confidence. But the steel design of the Knickerbocker contained serious departures from established practice, which are believed to have been a vital factor in the collapse, and while the architect may be culpable for not checking it, the fabricator, in whom he relied, cannot escape his moral responsibility for these departures. A tabulation of items showing departures from safe design is given elsewhere in the report.

3. Construction

Construction, which is a service carried on under the supervision of an architect and performed by the general contractor, consists in furnishing materials and building the structure as shown by the architect's plans and specifications. It involves the sub-letting of various portions of the work which the general contractor's organization does not perform, and generally carries with it the responsibility for the work performed under such sub-contracts. It does not include design. However, it may occur that a sub-contractor seeks to change some feature of the design in order to simplify the construction or because certain materials are difficult to obtain. In that event he prepares a design, or such drawings, as may be required to show the alteration, and these must be accepted by the architect before any change or substitution is allowed. In such instances the sub-contractor obviously becomes an agent of the architect in supplying a design, as well as an agent of the general contractor in executing the work. For ultimate execution of the work, in accordance with the design, the contractor should be responsible, but for the adequacy of the alternate design he should share no responsibility.

The situation here cited occurred in constructing the Knickerbocker, and the design has been found inadequate, but it should be pointed out that unless the construction has varied from this design, or from other plans and the specifications, the contractor should not be held responsible except in so far as he may have been a party to an infraction of the law. Otherwise expressed, he is responsible for the character of workmanship and materials as specified in his contract and for infraction of the building code.

No evidence has so far been found to indicate that the building was not constructed in accordance with the plans and specifications, except that evidence given at the coroner's inquest indicates that the contractor added a reinforced concrete band running through the full length of the wall which carried the main truss, and strengthened the hollow tile under the truss support with concrete. This, it was testified, had been done because the wall seemed to the contractor to be of inadequate strength and in need of reinforcing. An examination of the wreckage indicates that the contractor used materials of suitable quality throughout the construction and that the workmanship was of a kind that should be expected in work of this nature. Several defects of workmanship have been found in the structure, but they appear to be of a minor character and not involved in the collapse. These defects are discussed elsewhere in the report.

In view of the evidence obtained by the committee's investigation, and by that of the coroner, no responsibility appears to rest upon the contractor by reason of the quality of his work or any non-compliance with the plans and specifications; but by conforming to these instruments, as required in his contract, which did not provide for anchoring trusses to the walls, he was made a party to infraction of the building code. Under the Washington Code, which places responsibility for observance of its requirements upon "any person or persons, whether as principal agent or employee," it appears that violation thereof entails joint and several responsibility.

4. Ownership

Ownership is charged in the erection of a building, and especially of a building used for public gatherings, with securing such design and supervision as will insure its safety. It is the duty of ownership to insist upon adequate inspection and to pay a fee for architectural service sufficient to provide such inspection. If the owner presses his architect to reduce this fee below that commonly recognized as necessary to give adequate inspection he should not expect the building department to relieve him of responsibility for such action. Should the owner induce the architect to reduce the cost of structural design at the risk of endangering its safety, he jointly with the architect should share responsibility for the results.

In the case of the Knickerbocker, the architectural fee, as shown by evidence at the coroner's inquest, was lower than that advised by representative architects, and an examination of the building indicates that while the decorative features were elaborately executed, structural features were inadequately provided for. Whether any action of the owners resulted in this condition has not been determined, but, if so, the ownership should share the responsibility.

Recommendations

Investigation of the Knickerbocker disaster has forcefully emphasized four factors which have vital bearing upon the failure of this structure and which this committee believes should be called to the attention of owners, engineers, architects, contractors and public officials.

1. Building Approval and Inspection

Under the present system of providing funds and administering municipal building departments it is seldom possible to fully check every design or to provide constant inspection of the work—the appropriation is too small. Expenses of the department are often drawn from the general tax funds, and thus place a burden upon all taxpayers, for services rendered for the most part to but a few. Under this system the department does not receive sufficient funds to render the service desired.

More extensive service could be provided if a charge, depending upon the value of a structure and sufficient to pay for checking design and for inspection, were made for each permit. This would place the cost of such service upon those who build, and would require from the general fund only an appropriation necessary to cover clerical and other general expense of the department. The cost of permits upon buildings used for public gatherings could thus be made to provide whatever degree of inspection is advisable.

2. Design and Supervision

The expense of designing, drafting plans and supervising the construction of a modern building are fairly well established, and the fees which must be charged an owner to cover the expense of this work and provide a reasonable profit, are fixed within rather narrow limits. These fees cannot be substantially reduced without lowering the character of service rendered. They are generally adhered to by representative men of the profession and are recognized as a reasonable minimum charge.

Some members of the profession, however, on account of strong competition in the architectural field and the tendency of owners to shop for professional services as they would for coal, will accept inadequate fees; and when they do are obliged to reduce the expense of design and supervision to such an extent that they are unable to furnish adequate supervision or complete plans, specifications and details. This condition forces the contractor, whose function is not to design, to construct the building without sufficient drawings as best he can. The safety of a structure may rest upon these details and failure of the designer to provide them constitutes a dangerous gap in his service. In the case of the Knickerbocker the plans and specifications were not complete, and testimony before the coroner showed that the inspection was inadequate.

In any building there are items of construction unforeseen by the designer which must later be added, but when, on a structure like the Knickerbocker, costing about $77,000, there are more than fifty such items, there would appear to have been incompetence, indifference, or both.

The committee recommends that the fees of architects and engineers be made sufficient to enable them to give competent and complete service. Fees recommended by the American Institute of Architects and the American Institute of Consulting Engineers are reasonable and proper and have had recognition by the courts.

3. Standardized Building Code

Municipal building codes have generally developed independently by a process of accumulation, until it is now practically impossible for either an architect or a contractor to have cognizance of all the provisions in force in the various localities of his work. Many of those codes are deficient in vital particulars, to such an extent that an unsafe structure can be built without infraction of the regulations; for example, light and flimsy wall construction which in the Knickerbocker Theater was a weak element if not a direct cause of the collapse. A comprehensive and well-arranged code in any city would doubtless tend to reduce the possibility of disaster.

4. Registration of Architects, Engineers and Contractors

Licensing of architects and engineers before they are permitted to practice has been advocated by various groups within these professions for some time, but the effectiveness of this requirement in preventing disasters seems questionable. Such a measure might merely limit the number of persons engaged in these professions.

What is needed is a method of fixing a greater responsibility for safe and legal work. The committee believes that this can be accomplished by requiring designers, and constructors as well, in all branches of building work, to seek registration with the building authorities before permits are issued to them. Such registration should be withheld if the applicant is unable to show his competency, responsibility and willingness to comply with legal requirements. In accepting the permit the registrant would further assume responsibility for the safety and adequacy of his design and for its execution in accordance with the conditions of the permit.

While the registration fee might be nominal, the penalty attached to violations of the permit should be sufficiently exacting to make the provisions effective. Cancellation of the permit and loss of the right to operate for a given period would doubtless prove effective. Registration of this kind would tend to restrict the planning and erection of building to those who are competent and responsible—a result that is greatly to be desired.

This committee recommends that engineers, architects, contractors and public officials be urged to advocate application of these recommendations, and, if necessary, the adoption by proper legislative bodies of laws putting them into effect.

Motor Vehicle Speed in Relation to Road Destruction

Effect of Self-Propelled Traffic on Highway Surfaces—Impact as it is Affected by the Velocity—Tests With Trucks Under Various Conditions of Loading and Tire Equipment

By W. G. ROBERTSON
Secretary, Ontario Motor League

Paper read before the Ontario Good Roads Association

As an economizer of time, it must be conceded that the improved highway of to-day, taken in conjunction with the motor vehicle, ranks in importance with the railway, the telegraph and telephone. Rapidity of transit, whether of goods, passengers or messages, is indeed the outstanding characteristic of all these great modern developments.

It has been estimated from available statistics that the volume of this country's road-borne traffic is ten times that of its rail-borne traffic. There is no need to discuss the relative importance of the railway and the highway—both are essential, each being the complement of the other, but as speed is admittedly a prime factor in railway operation, it is worth while to consider this factor in relation to the highways which carry the great bulk of the nation's traffic.

Speed, for the purpose of this discussion, will be taken in the sense of rate of travel or velocity, rather than in the sense to make haste, perhaps unnecessarily.

There are many angles from which the question of speed of motor vehicles may be considered. It might be taken up from the standpoint of engine efficiency and fuel economy; from the standpoint of tire efficiency and economy; from the standpoint of experience and skill on the part of the driver; with regard to the factor of safety, or with regard to the effect of speed on road surfaces. Each of these various aspects of speed is worthy of serious thought and capable of considerable elaboration, but it will be necessary for the present to confine our attention largely to the effect of speed on road surfaces.

Speed a Factor in Destruction

It is well known that speed is a very important factor in the amount of destruction which results from the unrestricted use of the roads by vehicles. The impact increases very rapidly with increase of speed. It increases much more rapidly in the case of a truck equipped with solid tires than one equipped with pneumatic tires, because of the greater resilient qualities of pneumatic tires.

A report issued by the United States Bureau of Public Roads on the "Effect of Impact on Pavements" gives some interesting information on this subject, and shows that the impact resistance increases with the velocity, with the total weight of the vehicle and with increasing road-surface roughness. In these tests, the impact resistance of good asphalt or bitulithic or other smooth pavement, was practically negligible, and reached its highest values on granite-block roads with sand-filled joints and on badly-worn macadam pavements. The rate of increase of impact resistance with speed was most marked on the roughest roads.

Tractive Resistance of Various Roads

The following urban pavements are enumerated in the order of their desirability for vehicle operation from the point of view of tractive resistance at 20 kilometres (12.4 miles) per hour, as found in this investigation: (1) asphalt, (2) wood block, (3) hard, smooth macadam, (4) brick block, (5) granite block, with cement-filled joints, (6) cinder, (7) gravel, (8) granite block with sand-filled joints.

The equivalent grade at 20 kilometres per hour of badly worn city macadam road was found to be nearly three times as great as that of the best asphalt road tested. This means, at this speed, a consumption of energy at wheel treads of nearly three times as much on level macadam roads as on good level asphalt roads.

Increasing the gross weight of the vehicle by 12 per cent through load was found to have no effect on tractive resistance within the observed speed limits for smooth roads in good condition; but on rough roads, a distinct increase in tractive resistance with this extra weight was observed.

Tests have been made which show that increased speed of a vehicle equipped with hard rubber tires tremendously increases the impact which its wheels make on the roadway where there is any unevenness. On the other hand, where pneumatic tires are used, increased speed adds comparatively little to the impact. It has been suggested that these tests will be of great value, not only in settling questions of design, but may also lead to a rational basis for determining license fees for motor vehicles.

Trucks in Test

Trucks have been used in these tests, varying in size from a 1-ton up to a 7½ ton truck carrying an excess load. Each truck was run over a special recording device imbedded in the roadway and the impact which resulted when one of the wheels made a two-inch drop from a ledge built in the surface was recorded.

Recent tests were made with a 3-ton truck, loaded so that the weight on each rear wheel was 7,000 lbs., the unsprung portion being 1,700 and the sprung portion 5,300 lbs. The truck was equipped first with an old solid tire that was worn down to a thickness of one inch. Then, with exactly the same load on the truck, a wheel was fitted with a new solid tire, 2½ inches in thickness. And finally the truck was equip-

Speed miles	Old tire lbs.	New tire lbs.	Pneumatic tire lbs.
14.6	26,500	18,700	8,330
10.2	18,500	14,100	7,900
5.7	11,600	9,400	7,100

ped with pneumatic tires, 42 x 9 in., blown up to a pressure of 142 lbs. per square inch. Accompanying table shows very clearly the bad effect an old tire is likely to have on a road surface and the greatly lessened impact which is produced by trucks equipped with pneumatic tires. The tests show that, as the vehicle's speed was increased, the impact from the old hard rubber tire increased greatly. The impact from the new tire was somewhat less.

Diversity of Speed Regulations

In fixing speed limits for motor vehicles, legislators hitherto have given consideration mainly to the question of safety. Diversity of opinion as to what constitutes a safe maximum speed is reflected on this subject in different provinces and states. The state of Kansas sets 40 miles per hour as the upper limit of speed in the open country. California and a number of other states draw the line at 35 miles per hour, while 30 miles per hour is about the average for all the states.

Thirty miles per hour is the maximum speed limit in British Columbia, while the other Western Provinces fix no limit other than requiring speed at all times to be reasonable, having regard to traffic. In Ontario, Quebec and Nova Scotia, the upper limit has been fixed at 25 miles per hour. New Brunswick sets no definite speed limit other than what is reasonable, having regard to traffic, while Prince Edward Island, but recently opened up to the automobile, puts the ban on a speed in excess of 15 miles per hour.

Truck Limits Restricted

In Ontario, the Load of Vehicles Act (Section 5) stipulates that no vehicle carrying a weight in excess of four tons, including the vehicle, shall be operated on any highway at a speed greater than 10 miles per hour; and no vehicle carrying a weight in excess of six tons, including the vehicle, shall be operated upon any highway at a speed greater than eight miles per hour.

The speed limit for trucks provided in the Ontario Act are extremely restrictive. If modified in conformity with recent experience, all commercial vehicles equipped partially or all around with solid tires would be required to conform to the following speed schedules.

Gross weight.	Open Country Highways Miles per hour.
10 to 14 tons	12
6 to 10 tons	15
2 to 6 tons	20
Under two tons	25

Minimum Rate

To fix the speed limit of commercial vehicles at an extremely low figure means also interference with the free movement of general traffic on the hghways. On a road of average width, when there is a steady stream of traffic in opposite directions, it is at once both difficult and dangerous to pass a succession of slow-moving vehicles, in the face of oncoming traffic. The great increase in motor truck traffic indeed points to an early necessity of providing such width on main highways as will enable trucks and slow-moving vehicles to travel the outside of the road, and leave a lane of sufficient width for two lines of the more swiftly-moving passenger cars. Under present conditions it is just a question whether it might not be conducive to safety to require all motor vehicles to travel at not less than a minimum rate of say twelve miles per hour under normal traffic conditions.

Width of highways, degrees of grades and curves, nature of road intersections, ditches and railway crossings and volume and kind of traffic, are all factors which must be considered in determining speed from the standpoint of safety. So complex are these factors that it is impossible to state what might be considered a reasonable speed on any but a straight-away stretch of country road, without taking into account local conditions. Vigilance and sound judgment are essential to safe driving everywhere and no arbitrary speed limits can be devised which will relieve the drivers of motor vehicles from the ever present obligation of giving due regard to constantly changing traffic and road conditions.

Annual Dinner of Toronto Builders

On April 4, the Toronto Builders' Exchange & Construction Industries held its annual dinner in the Board of Trade rooms. The features of the meeting were addresses by Mr. George Clapperton and Mr. Fred Armstrong. The former gentleman spoke on the efforts of the Kiwanis Club to improve the apprenticeship system in the manufacturing and building industries. The members of the Builders' Exchange were urged to take advantage of this feature of the Kiwanis Club's work and to apply to that organization for a boy whenever an opening occurred. Mr. Armstrong, of the Port Hope Sanitary Manufacturing Company, dwelt upon the building outlook for the present year. His speech was marked with optimism and confidence.

A gold watch was presented to the retiring president of the exchange, Mr. J. M. Scott, while a club bag was given to Mr. C. F. Till in acknowledgement of his splendid services as chairman of the Finance Committee.

New Book

"The Ministry of Health Requirements as to Sewage Purification," by S. H. Adams. This book is the 4th edition of a publication which was first brought out in 1902 to collect and compile the unwritten but official requirements of the British Local Government Board. In the new edition, which is the first to be published under the auspices of the newly formed Ministry of Health, many additions have been made, both original and otherwise, but chiefly in the form of selected passages from the reports of the Royal Commission on the Treatment of Domestic Sewage and Trade Waste. The text gives an outline of the various methods of sewage purification and disposal, with a comprehensive summary of the requirements of the Ministry of Health in regard to sewage disposal equipment and operating methods. A large number of tables and diagrams compress the information into small space. There is also considerable memoranda of useful assistance to all municipal engineers, sewage disposal plant officers and similar officials. The book is published by the St. Bride's Press, Limited, London, England, and sells in cloth binding at 6s. net.

Trade Incorporations

Rapid Building Construction Co. Ltd., with head office at Toronto, capital $40,000, to carry on the business of building and wrecking contractors.

Doran Construction Co. Ltd., with head office at Ottawa, capital $100,000, to carry on the business of general contractors and engineers.

Lessard, Limited, with head office at Quebec, capital $10,000 to carry on the business of general contractors

Reducing Equipment Waste

A Talk Before the Building Division of the Associated General Contractors at Their General Meeting

By F. J. C. DRESSER
Dresser-Minton Co., Cleveland, Ohio.

Equipment problems are largely individual problems of the contractor. It depends largely on the class of work he is handling and the particular job that he has in mind.

A good many times equipment is brought for a particular job that does not apply, possibly, to the particular line of building work or any other phase of construction work in which this contractor is vitally interested, so in order to eliminate the waste or the duplication of equipment, or the having a job over-equipped, it is up to him largely to standardize his own proposition. I do not know as it could be applied nationally to the construction work.

How Tools Accumulate

A contractor generally has to consider his equipment as second in importance to his organization. He may have a good personnel, but at the same time he may not be able to give that personnel the tools and equipment to do the job properly or efficiently. It often happens that plant failures on work are due in a great many cases to the lack of maintenance and repair. For instance, when you are moving on to a new job and you pick up a tool which has been lying in the yard and which you think has been repaired, but hasn't, the result is when it gets to the job it falls down. Rather than stand the cost of moving the tool, the repairs and the time lost, nine times out of ten—or possibly not that proportion—you will buy a new tool and in a busy season that also is moved to the yard after the job is done. The result is that you have a lot of idle equipment, and it keeps you guessing as to just how it has accumulated. I have seen many a yard at the end of the season that was virtually stacked with tools that were accumulated in this way; and for the simple reason that the tools did not have attention or the work was not properly planned.

Planning the Lay-out

I have been in some of these concrete plants where contractors have made an endeavor to standardize their equipment. My experience has been largely with reinforced concrete work, where plants were set up. There are three sizes: a half-yard, three-quarters yard and a yard, depending upon what the job demanded. Of course the job was planned and scheduled in the office prior to the time the equipment was moved to the work.

Of course in much work one finds that the plans for the installation of these plants are prepared in advance. The distances from the motor to the hoist and to the mixer are all prepared and handed direct to the superintendent, and if he has a particular job that he knows is limited to possibly 160 to 200 yards on a floor, he knows he is going to get a half-yard plant. His request is probably made accordingly. In connection with these plants, the equipment can be standardized as far as runways, horses, buggies and other features that are involved go.

Selecting Equipment

We used an electric power unit entirely for a half-yard plant using a 40 h.p. motor and by using a Lidgerwood hoist with a countershaft we drove the mixer and also operated the hoist from one motor. The same was done with a three-quarter yard plant, for which a 50 h.p. to a 60 h.p. motor would suffice. In a yard plant a 75 h.p. motor is used.

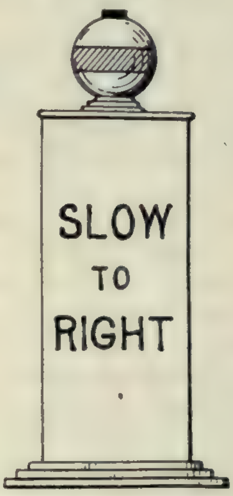
In my first experience with these plants I was rather skeptical of an electrical motor for the simple reason that I did not think they had the sturdiness that I had been accustomed to seeing in a hoisting engine, but we had a pile pulling job on one of these operations and I saw a 75 h.p. motor which was hooked up to an A-frame and two six-sheaved blocks, pull 76 piles, and I was pretty well sold to a motor being a good tool on a construction job. Furthermore, we found the cost of operation was decidedly less than any steam equipment plant that we had.

One man operated the motor and the hoist and it depended largely on the amount of other material—for instance, brick—that one had to handle in the work, but there were no other hoists necessary. We could, by just making a slight change, put a platform in the tower (as undoubtedly many of you have done), and handle our material in that way very nicely.

In city work where space around the job is undoubtedly scarce, where smoke is restricted and with the present prices of smokeless coal so high, it is my opinion that these electrical equipment plants come nearer answering the needs than possibly either gasoline or steam, and furthermore, the cost of installation of a plant of this kind is decidedly less than of these heavy steam plants.

New Style of Street Traffic Guiding Sign

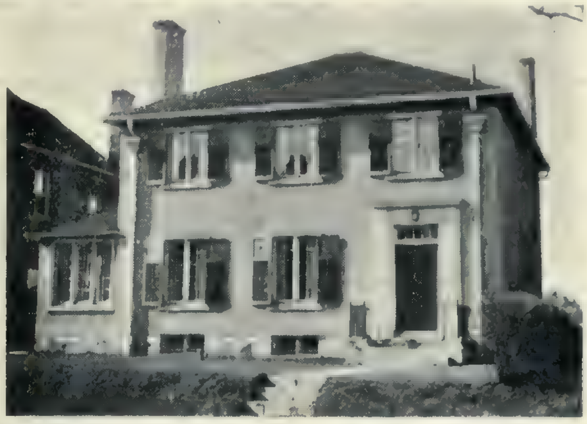
The Ottawa Improvement Commission has lately put up a new type of sign to direct the traffic on the streets where it is most active. The accompanying drawing showing the new sign is self explanatory. It measures 5½ ft. in height by 16 in. wide on both sides. On the top is set a globe painted white with a colored strip following its horizontal axis. The globe is intermittingly illuminated at night. The body of the sign is painted white with the directing letters in black. This new type of vehicle director is proving very satisfactory.



The council of Essex, Ont., have instructed their engineers, James, Proctor & Redfern, Limited, Toronto, to prepare a report and advise them on an increased water supply.

The Contract Record's

Weekly House Suggestion No. 16



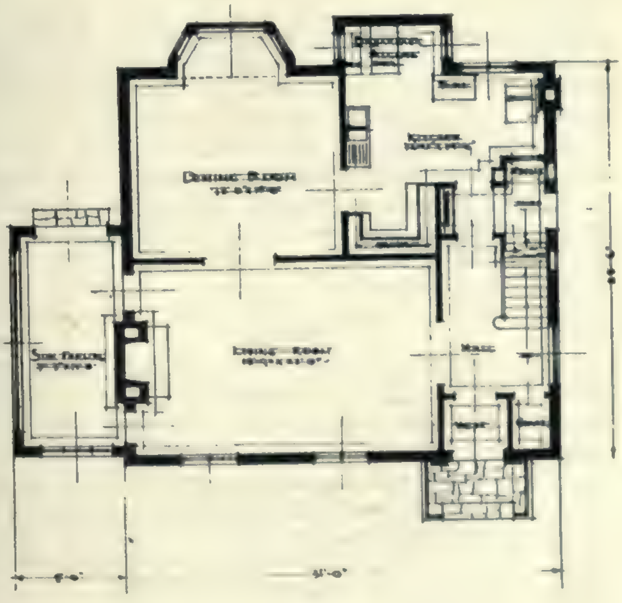
The exterior appearance of the attractive seven-room residence illustrated herewith suggests careful architectural treatment. Variegated colored stone was used in the base, with wire cut brick foundations. The general construction is of hollow tile with ivory tone stucco facing. Wooden shingle roofing was used, stained a reddish brown. The shutters are done in a peacock blue, as is the front door. Wrought iron railings, with bronze tops, are used on the main entrance, the general treatment of which is in white pine, ivory toned. The drive to garage and entrance walk are laid with flagstones. The windows are of the casement type with plastered jambs on inside (with angle beads and finished in Keen's cement.)

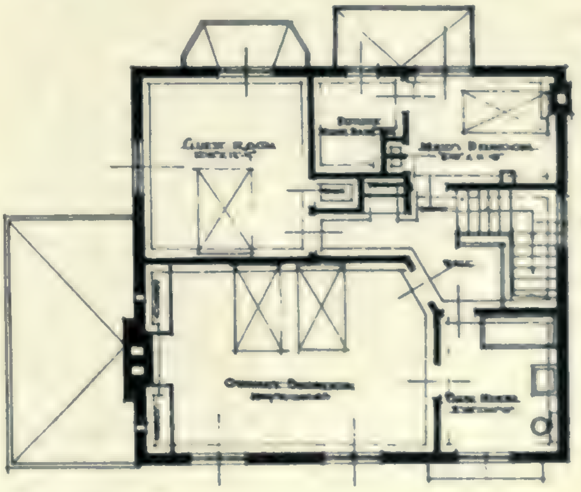
The ground floor comprises living room, dining room, kitchen, breakfast alcove and sun parlor, the trim throughout being of whitewood, with white enamelled finish. All doors are of whitewood also, stained mahogany. The staircase is also finished in white enamel, with mahogany railings, newels, etc. The vestibule and sun parlor are laid with a brown floor tile, the flooring in the latter room being reinforced with ¼ in. rods, spaced 6 in. on centres, with concrete slab for tile. The flooring in the balance of the house is of oak throughout. The feature of the living room is the handsome fireplace, which is bolection trimmed type with tile facing and hearth. On either side of the fireplace are French doors, leading to the sun parlor. The kitchen is complete with built-in ironing board, refrigerator, broom closet and cupboards.

The bedroom flat, like the ground floor, is finished in white enamel and mahogany, and comprises three bedrooms and toilet. The feature of this flat is the owner's room. This room is especially equipped with built-in wardrobes, hat box closets over, and also contains a built-in mirror. A clothes chute is constructed in the bedroom over the kitchen and continues down through the kitchen to the laundry in the basement. The bathroom has a tile terrazzo floor and 4 by 4 tile walls to a height of 4 feet.

The basement provides accommodation for heating plant, (which is a Steel and Radiation boiler,) for coal storage, laundry and maid's toilet off the latter room. There is also an instantaneous Rudd gas heater situated in the basement.

The house was designed for Mr. H. C. Johnston by Mr. Maurice D. Klein, architect, 71 King St. W. Toronto. It is located on Highlands Ave., Rosedale, Toronto, Ont.





Mainly Constructional

East and West—From Coast to Coast

A new organization known as the Fredericton Builders' Association was organized recently at Fredericton, N. B., and includes a large representation of all branches of the building industry. The association was formed for the primary reason of endeavoring to bring about a return to normal building costs and to encourage construction in that district. The officers of the new association are:—President, Robert Forbes; vice-president, D. J. Shea; secretary, Harry C. Moore, treasurer, W. Bruce Dayton.

It is stated that the Dominion Alloy Steel Corporation, who have held an option on 1,200 acres of land on the Indian Reserve at Sarnia for the past two years, will shortly commence on the construction of a $3,000,000.00 plant for the production of steel for use in automobile construction.

It is reported that borings for the determination of the location of the proposed Detroit-Windsor bridge have been completed, but as yet no site has been decided upon, as this important matter requires thorough consideration. Mr. Charles Evan-Fowler, chief engineer of the structure, recently made a public statement denying many reports that have been current which have declared that the bridge was to be located at certain sites. He states that these reports did not emanate from his office and lays the blame for them to unscrupulous real estate men who are endeavering to sell their lands at large profits.

A report from Port Arthur states that owing to the stand taken by the bricklayers of that city, in refusing to accept less than $1.00 an hour during the present season, the Provincial Pulp & Paper Company have decided to alter their plans in connection with the construction of a $1,500,000 addition and use concrete instead of brick. The action of the bricklayers means that the Superior Brick & Tile Company, who were to secure the order for the brick, will remain closed, as there is not sufficient business in sight to keep things moving.

The Canadian section of the American Waterworks Association will hold its annual meeting at Brantford, Ont., on May 12 and 13, prior to the convention of the parent association, which will be in session in Philadelphia, May 15 to 19. R. C. Harris, commissioner of works, Toronto, is chairman of the Canadian section.

That clause in Mr. Crawford's bill which placed brick and tile manufacturing plants under the smoke by-law was defeated by the Private Bills Committee at the Parliament Buildings, Toronto, recently. Mr. A. W. Ballantyne spoke on behalf of the brick manufacturers and stated that one firm had developed a plant which did away with the smoke nuisance, but it was found that the brick were not burned right. Others suggested that this type of plant, if arrived at, would increase the cost of production.

The Wabash Railwiy Company, it is stated, has decided to erect locomotive repair shops at St. Thomas, Ont., at a cost of $500,000.

The annual convention of the Master Painters' and Decorators' Association will be held at London, Ont., on July 11, 12 and 13. Extensive preparations are being made by the Ottawa Branch to make this the biggest gathering of this association ever held.

Building permits issued during the month of March, at London, Ont., total $163,045, an increase of $11,390 over the figure for the corresponding month last year. The permits for the present year, to the end of March show a total value of $240,545, or $16,670 below the total for the first three months of 1921. The number of permits this year, however, is 221 compared with 178 for this period last year and it is safe to say that this year's figure, taking into consideration the reduction in the price of building during the past year, represents a larger total of building, than the slightly larger figure for the first three months of 1921.

It is said that the proposedl erection of a building in Winnipeg, to house the offices of the medical and dental profession of that city, is meeting with general approval, over 100 physicians and dentists having signified their intention of taking space in the block. The rents paid would be controlled by the members of the professional association.

There is talk in Ottawa of combining the Department of Highways with the Department of Public Works. The former department is at present connected with the Department of Railways and Canals. Hon. Dr. King, the new Minister of Public Works, under whose charge the highways would come under the proposed re-arrangement, previously was in charge of the Roads Department in British Columbia and is thoroughly familiar with the subject.

The Niagara River Bridge Company, owner of the cantilever bridge over the Niagara River at Niagara Falls, Ont., announces that a new bridge will be built this year. An application to Parliament will be made at the present session to increase the capital for that purpose. The old bridge will be used until the new one beside it is completed. The bridge is used exclusively by the railroads.

The new filtration plant at London, Ont., situated at the corner of Horton and Ridout streets, was put in operation recently. The plant has a capacity of 3,500,000 gallons a day, took six months to construct and cost in the neighborhood of $50,000. This plant will look after only the well water supply of the city, the spring water from Springbank not requiring filtration treatment.

Word has been received from St. Catharines, Ont., that the plumbers and painters have gone on strike against the employers demands that they accept a decrease in wages, from 90c. to 75c. in the former trade and from 70c. to 60c. in the latter.

Personal

Mr. Martin Mikel has been elected to succeed J. H. Wood, who resigned recently, as road superintendent of Kitchener, Ont.

Mr. George Hogarth, chief engineer of the Highways Department of Ontario, was presented with an honorary membership in the St. Thomas & Elgin County Motor Club, at a recent meeting of that body in St. Thomas.

Mr. H. W. Davis, architect, 80 St. Francois Xavier St. Montreal, will remove his offices to 42 Belmont St. Montreal.

Messrs Graham & Wrench, interior decorators, have opened offices on Mountain St. just below St. Catherine St. Montreal.

Obituary

Mr. Ignace Bilodeau, a well-known contractor of Quebec City, died recently at the age of 81 years. He carried out many important building works and in the past 20 years built most of the concrete sidewalks in the city.

Mr. Wm. H. Armstrong, contractor of British Columbia, died at Vancouver recently at the age of 65 years, following a brief illness. Deceased was born in Stratford, Ont., and during the period of the war was controller, for the Dominion Government, of coal mines in Alberta and eastern British Columbia.

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Each County Should Have a Conference for Its Road Organization

Within the past few weeks the county engineers of at least two counties in Ontario have organized conferences for their respective highway staffs with a measure of success that should commend such a policy to other counties and townships. In Victoria county, the first annual conference of the county road system foremen was held on March 20, under the direction of that county's efficient and energetic engineer and road superintendent, E. L. Miles, M.E.I.C; in Ontario county also, a similar conference was organized by D. J. Kean, A.M.E.I.C., who has displayed unusual interest in giving this particular constituency the best in road building practice. Over 200 men attended the former conference, while 60 were present at the other meeting, all gathered to discuss their local road building problems and by mutual exchange of opinions and experiences to prepare themselves the better to handle a big season's work.

There is nothing, we believe, that will raise the standard of the highways, improve the quality of the workmanship and increase the interest of the men in the work they turn out than just such conferences as these. No one man possesses a monopoly of ideas and by meeting together, different viewpoints can be pooled, those of merit adopted and the others rejected. The result will be that the men will go back to their work with clarified ideas, a new incentive and renewed energy. Team work—an essential for successful road building—will naturally follow and the best will be got out of the whole highway organization.

County conferences, such as the ones instituted by Ontario and Victoria counties, are bound to overcome the difficulties that accompany such unwieldy meetings as the provincial and Dominion road organizations hold. The experience of many who have attended the larger conferences is that much benefit is lost because they are so large as to lose the element of personal contact and intimacy of discussion—features that should be emphasized if road building knowledge is to be properly disseminated. In large meetings, too, the local atmosphere fades into insignificance and only generalities can be satisfactorily dealt with. These objections can be successfully overcome by meeting by county units. In that way the local peculiarities of the highway problem can receive suitable consideration, the men can exchange their ideas more freely and team work can more successfully fostered.

In Ontario, the provincial highways department holds an annual conference for county road superintendents and engineers—a practice that has been eminently successful and productive of good results. But the benefits of this excellent policy may be further enhanced, if each county superintendent would, following the provincial conference, call together his foremen, in the manner in which Mr. Miles and Mr. Kean have done this year. We are sure that such a practice will be justified by the results, as it has been in Victoria and Ontario counties. Their precedent is certainly to be commended.

Cheaper Mortgage Money is Becoming Available for Building

Cheaper mortgage money is on the way for builders in Ontario; in fact, the down-turn has already started, according to the report of V. Evan Gray, Ontario Registrar of loan corporations, issued recently.

"The supply of money for mortgage loans has considerably increased during the year," says Mr. Gray. "The life insurance companies have now a considerably greater proportion of their funds available for mortgage loans than was the case a year ago. Their commitments on the purchase of Victory bonds have now been absorbed and the falling rates of interest available on municipal and government bonds have naturally been a material factor in effecting the re-entry of the life insurance companies to the mortgage field. For the same reason there is a larger supply of the funds of private investors and of estates available for mortgage purposes."

The registrar says that as a result of the holding up of extensive building operations and the increased supply of money available, interest rates on mortgages, which went up to 7½ and 8 per cent, are now down to 7 and 7½ per cent. "The continuance of these tendencies is to be expected during the present year," he adds, "and there are already signs that they are contributing to a revival of activity in building operations."

Mr. Gray states in his report that, owing to the continued progress of deflation, the act of last session, permitting loan corporations to extend their business of receiving local deposits has not produced the result hoped for. The total savings deposits held by trust and loan corporations at the beginning of the year 1921 was $34,510,293, and at the end of the year $35,954,958. Compared with the chartered banks, which had a decrease in deposits, the loan companies, however, made progress. Mr. Gray is convinced that the effect of the legislation in providing substantial additional sums for mortgage purposes, has only been postponed.

"Several companies have during the past year increased the rate of interest from 3½ to 4 per cent," he comments, "and my information is that this departure is likely to be followed by others during the present year."

Progress on Welland Canal

About 70 per cent of the total construction work on the new Welland Ship Canal yet remains to be done, according to information tabled in the House of Commons on April 10. The work still to be done comprises the completion of sections 1, 2, 3, 4 and 5; the construction of sections 6, 7, 8 and 9, the lock gates, superstructures of bridges and minor details. The work completed comprises 63 per cent of the work on sections 1 and 2, 51 per cent of the work on sections 3 and 4 and 72 per cent of the work on section 6.

The gross amount expended on the canal work up to March 31, 1922, was $30,588,026.07, less a credit for cash received on account of the plant and materials, etc., from contractors for sections 1, 2 and 5 of $1,149,761.25, less a further amount to be paid by contractors for sections 1, 2 and 5, in accordance with their contracts on account of plant, etc., totalling $952,883.11; less a further $2,151,655.88, which is the estimated value of plants, etc., to be taken over by contractors for sections 3 and 4, leaving a net expenditure on the work to March 31, 1922, of $26,333,725.-83, which sum includes other redeemable assets.

If ample funds are available for the purposes of the work the canal will be ready for traffic during the year 1927. At any rate, the Government will finish the work as soon as possible, and this year it will proceed with the construction of locks on sections 1, 2 and 3, and excavation on sections 1, 2, 3, 4 and 5.

Montreal Contractors Discuss Lower Wages for Building Mechanics

While a large amount of construction work is expected and is in sight in Montreal this season—estimated by Mr. D. K. Trotter, secretary of the Builders' Exchange, at $25,000,000—the general contractors feel that the question of cost, particularly of wages, will be a vital factor in relation to a considerable portion of this work being carried out. At a meeting of the General Contractors' Association held week before last, the subject of wages was discussed in detail. The general opinion was that wages should be reduced ten per cent, this following on a similar reduction last year. At the same time it was felt that the members of the various sections should discuss the question before a definite decision was arrived at, having regard to the fact that the sections such as plumbers, plasterers, bricklayers, etc., did the actual hiring of the men to a very large extent. It was therefore decided to hold another meeting of the General Contractors' Association, pending which the sections will hold meetings to discuss the matter of wages. In the view of the Association costs are high enough as far as Montreal is concerned. During 1921 the wages of carpenters were from 30 to 65 cents an hour, the average for a good man being from 50 to 55 cents. Bricklayers received 90 cents, and now obtain 80 cents an hour, although some contractors have been able to get men at less.

The following committee was appointed to study the question of guaranteed quantities to be furnished by architects: Messrs. C. Cook, R. McLean and A. Plamondon.

A small committee was appointed to go into the question of the information to be supplied by contractors to Government Departments in Ottawa. It is complained that the information desired is of too detailed a character, and it is suggested that the forms to be filled should be modified and simplified.

The directors of the Builders' Exchange have appointed Messrs. J. P. Anglin, A. Plamondon and Douglas Bremner to report on the subject of contractors' responsibilities for buildings in the Province of Quebec. This refers particularly to the ten years' guarantee, which the Association believe to be too onerous.

The directors of the Exchange have also appointed Messrs. A. Leclair, A. Gratton, D. W. Ross and John Quinlan to take steps to secure the repeal or modification of the scaffolding Law passed last session by the Provincial Legislature.

Ontario Compensation Rates Increased

The Workmen's Compensation Board of Ontario have recently made some changes in the rates applying to certain trades of the building industry, the changes, with one exception, being increases. These were found necessary to meet the extra expenditure caused by an increase in the number of accidents during the past year. The rates are as follows:

Trade	Old	New
Brickwork	$1.80	$2.00
Concrete, cement work	1.80	2.00
Plastering	1.20	1.80
Lathing	1.20	1.80
Plumbing, heating etc.	1.50	1.30
Painting	1.20	1.60
Decorating	1.20	1.60
Excavation	1.80	2.00
Blasting work	6.00	10.00
Wrecking buildings	6.00	10.00
Moving buildings	3.50	5.00
Window cleaning	3.00	5.00
General construction, including several trades	1.80	1.80

Building other than by contract.—Regulation 53 provides that any person, though not in the building contracting business, who employs workmen to put up any building, which he intends in whole or in part, to sell or let, or who, no matter what his intention, employs workmen to build a house within three years after he has previously built another house, is to be included in Schedule 1. Reg. 46, (k), however, restricts this provision to cases where such person employs more than three workmen.

The Woodhouse Crushed Stone Co. Limited, with head office at Port Dover, Ont., capital $40,000, to carry on the business of quarrymasters.

Contract Let for Large Hospital in Essondale, B. C.

New Building for the Provincial Mental Hospital will Cost $573,000 Exclusive of Heating—A Four-storey Structure, 266 by 148 Feet, of Reinforced Concrete Construction

One of the largest building contracts awarded in British Columbia for some time is that for the erection of the new building to house acute cases at the Provincial Mental Hospital at Essondale, B. C. There were five or six tenders in for the work, which was let to Messrs. McDougall & McNeill, Ltd., Vancouver, B. C., for the lump sum of $573,800.00, which includes everything except the heating and portions of the ventilating equipment.

The bulding will measure 266 feet in length by 148 feet in depth over all, and is to be four storeys in height. It will comprise a central portion with wings connected by a corridor running the length of the building. It will be of reinforced concrete construction as to frame, with concrete curtain walls faced with brick. The roof is to be mainly slate and where flat roofs are necessitated the Barrett Specification roof will be used.

B. C. Materials as far as Possible

A study of the specifications reveals some interesting details of the proposed building, which when complete will embody the latest and best in structure and equipment. A notable feature is the provision that all materials are to be of British Columbia manufacture, necessarily modified, however, by the fact that many of the details of equipment are not manufactured in the province at present, and must be obtained outside.

British Columbia cement is specified, and would be used in any case, as it is a high quality product, manufactured on Vancouver Island, and is sold at a lower price than is obtainable anywhere in the Dominion, with the exception, possibly, of Montreal. By far the greater area of roof will be covered with slate, for which No. 1 quality Welsh slate is specified. Certain small flat roofs are included in the plans, and for these Barrett "AA" specification is provided. All windows throughout the building are to be fitted with steel sash, and for this "Fenestra", manufactured by the Canadian Metal Window and Steel Products Co. of Toronto, is mentioned as acceptable.

Most of the floors throughout the building will be finished with mastic, and the Insulite Mastic Flooring, manufactured by the Insulite Chemical Co., of Aurora, Ill., is specified. Messrs. Evans, Coleman & Evans of Vancouver, and Victoria, are mentioned as the British Columbia distributors for this product. Careful specifications are drawn for the laying of the mastic, which is to be of a finished thickness of ⅜ in. and is to be applied in five coats. An expert layer from the manufacturing plant is to be employed by the contractor for this purpose, and a small area is to be layed and receive the architect's approval before the main portion of the work is proceeded with. The flooring of bathrooms, laboratories, treatment rooms and corridors will be of white hexagon tile, laid in cement.

There will be one main elevator in the building, which will be of Otis-Fensom make, type B-22-E. This will be of 2,000 lbs. capacity, and will have a speed of 250 feet per minute. A complete set of safety devices of the latest pattern will be incorporated, including electro-magnetic controller arranged to automatically return to the "stop" position if accidentally released by the attendant. An Otis patent wedge-clamp safety latch will be provided, as also automatic limit switches at top and bottom of run and a safety potential switch which will automatically open the main circuit leads to the elevator engine on the failure of current supply. Two dumb waiters are also included, and will be of Otis-Fensom make. These will be full automatic in operation, a bank of buttons being provided at each floor so arranged that a momentary pressure of any button will either call or send the waiter to the floor selected.

As in all hospital buildings, the plumbing is a large item and includes a large number of special fixtures, including baths and showers of various types and special heat treatment fixtures in certain of the laboratories, in addition to the ordinary operating room equipment, surgeon's sinks, etc. The contractor, as is usual, is required to furnish layout plans for the piping throughout the building but it is particularly specified that no Dunham system or galvanized iron work is to be included in the drainage system, which is to be of cast iron throughout, with lead and oakum joints. Pipe space is provided between the reinforced concrete floor slabs and the suspended ceilings on each storey. An item of $4,000.00 is allowed for the provision of refrigerators, the selection of which will be in the hands of the provincial authorities.

The electrical portion of the work is also a large item, and includes wiring and equipment for lighting, power, telephones, fire alarm system, signal lamp system, and a time clock system. No motors are included in this contract, although several will be required for the ventilation system, which with the heating, however, will be let as a separate contract. A main switch board consisting of four 28 in. panels will be installed, and the contractor, in connection with the working drawings to be supplied covering the entire installation, is to submit for approval his suggestion as to the arrangement of switches and instruments on the board. Two 50 kw. transformers are to be installed for the lighting circuits, and three 25 kw. transformers for the power lines are also to be provided.

The interior finish of the building will be of the best quality and workmanship, and on the ground floor will be in mahogany brought to a piano finish.

The building is under the jurisdiction of the Provincial Department of Public Works, of which Mr. P. Philip is chief engineer, and is under the direct charge of Mr. D. E. Whittaker, provincial architect. Construction is expected to commence forthwith.

Installed Water Wheel Capacity in Canada Totals 2,763,000 h. p.

A Resume of the Water Power Resources of the Dominion, Brought up to Date by the Water Power Branch, Department of the Interior, Shows 300,000 h.p. Added During 1921

Present activity in hydro power development warrants a further statement as to the extent of Canada's water power resources and as to the degree of their utilization. Last year has been one of substantial progress, there having been brought into operation new installation to the extent of 300,000 h.p. The installed water wheel capacity now totals to 2,763,000 h.p. with much new construction actually under way and many further enterprises in prospect.

During the past two years there has been under way in the Dominion Water Power Branch a careful re-analysis and computation of the water power resources of the Dominion. All existing stream flow and power data, available from federal and provincial sources, have been systematically collated, analysed and co-ordinated with a view to preparing on a uniform basis from coast to coast, revised estimates of the power available. While the analysis is not yet finally completed, sufficient progress has been made to warrant the publication of the figures given herein.

The total available and developed power resources are presented in a manner not heretofore adopted. A consideration of the figures will indicate that they place the water power resources of the Dominion in a much more favorable light than have previously published compilations.

While the resources have been exhaustively analysed in so far as the information available will permit, it should be kept in mind that only very meagre data is to hand in many districts and for many rivers.

Basis of Computation

The figures for undeveloped water power listed in Table I are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration is definitely known or at least well established. Many rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the more unexplored northern districts. Nor is any consideration given to the power concentrations which are feasible on rivers and streams of gradual gradient, where economic heads may be created by the construction of power dams. excepting only at such points as definite studies have been carried out and the results made matters of record.

In brief, the figures hereunder are based on definite rapids, falls and power sites, and may be said to represent the minimum water power possibilities of the Dominion.

The power estimates have been calculated on the basis of 24-hour power at 80 per cent efficiency on the basis of "ordinary minimum flow" and "estimated flow for maximum development." The "ordinary minimum flow" is based on the averages of the minimum flow for the lowest two consecutive seven-day periods in each year, over the period for which records are available. The "estimated flow for maximum development" is based upon the continuous power indicated by the flow of the stream for six months in the year. The actual method of determining this flow is to arrange the months of each year according to the day of the lowest flow in each. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in this month determines the maximum for that year. The average of such maximum figures for all years in the period for which data are available is the estimated maximum used in the calculation.

This estimated maximum development is based upon the assumption that it is good commercial practice to develop wheel installation up to an amount the continuance of which can be assured during six months of the pear, on the assumption that the deficiency in power during the remainder of the year can be profitably provided from storage or by the installation of fuel power plants as auxiliaries. The correctness or otherwise of this assumption for any particular site can only be definitely settled by the careful consideration of all circumstances and conditions pertinent to its development. The method, however, enables us to make a fairly satisfactory overall estimate of the maximum hydraulic power available, as distinctive from the estimated ordinary minimum power available.

Available and Developed Totals

The recorded power available throughout the Dominion, under conditions of ordinary minimum flow and within the limitations set out in the foregoing, is 18,255,000 h.p. The water power available under estimated flow for maximum development, i. e., dependable for at least six months of the year is 32,076,000 h.p. (For details see table I).

There are installed to date throughout the Dominion water wheels and turbines to the extent of 2,763,000 h.p. However, it would not be correct to place this figure in direct comparison with the maximum or minimum available power figures quoted above and therefrom deduce the percentage of available water power resources developed to date. An allowance must be made for the average ratio between the water wheels installed and the power available.

An analysis of the water power plants scattered from coast to coast, concernig which complete information is available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 30 per cent greater than the six month flow maximum power. Applying this, the figures quoted above therefore indicate that the at present recorded water power resources of the Dominion will permit of a turbine installation of 41,700,000 h.p. In other words the present turbine in-

Table 1—Available and Developed Water Power in Canada

Province	Available 24-hr. power at 80 % efficiency At ordinary min. flow h.p.	 At est. flow for max. dev. (Dependable for 6 mos.) h.p.	Turbine Installation h.p.
1	2	3	4
British Columbia	1,931,142	5,103,460	305,315
Alberta	475,281	1,137,505	33,187
Saskatchewan	513,481	1,087,756	
Manitoba	3,270,491	5,769,444	104,147
Ontario	4,950,300	6,808,190	1,212,650
Quebec	6,915,244	11,640,052	1,015,385
New Brunswick	50,406	120,807	30,180
Nova Scotia	20,751	128,264	46,948
Prince Edward Is.	3,000	5,270	1,869
Yukon & Northwest Territories	125,220	275,250	13,199
	18,255,316	32,075,998	2,762,880

stallation represents only 6.6 per cent of the present recorded water power resources.

Progress During Past Year

During the year 1921 the readjustment of values following war time inflation made substantial progress. This readjustment necessarily brought in its train many business and financial difficulties and the lack of confidence in trading circles generally led to a reluctance of capital to embark upon new enterprises. Employment fell off with a corresponding diminution in popular purchasing power and in consequence there has been a general tendency to mark time while readjustment advances the further step which will bring costs within the reach of the normal spending power of the community both individual and corporate.

The hydro-electric industry, though naturally affected by the general depression, suffered no setback and in fact, the horse power installed during 1921, 300,000 horse power, stamps it as one of the most progressive years in Canadian water power history .

The progress of development is somewhat difficult to follow from year to year because the year is too short an interval. From three to five years or even longer often elapses between the first consideration of development and the delivery of power. Again, most projects commence with an initial installation much less than the ultimate projected capacity and new units of machinery are installed from time to time as the load develops. In other words, what we may call the scoring column often does not reflect new construction for some years after such construction has been actively under way, but continues to record new scores from old developments.

The 300,000 horse power installation during 1921 is made up of both kinds of growth and in addition a considerable amount of new construction was initiated which ensures that as old power plants reach their ultimate capacity new ones will take their place in maintaining the continued growth and prosperity of Canadian hydro-electric enterprise.

Developed Water Power in Canada

The 2,763,000 h.p. at present installed throughout the Dominion is ,apportioned to the following uses (See Table 2):

2,013,000 h.p. in central electric station for general distribution purposes, such as operation of street railways, operation of mines, operation of electrochemical and electro-metallurgical industries, operation of pulp and paper mills and for general industrial and domestic use.

476,000 h.p. installed in pulp and paper mills. In addition there is used in the pulp and paper industry 161,000 h.p. purchased from the central electric station installation.

274,000 h.p. installed in industries other than central electric stations and pulp and paper mills.

The total installation for the Dominion averages 315 h.p. per thousand population, a figure which places Canada second only to Norway in the per capita utilization of waterpower among the countries of the world.

By far the most important use to which the development of water power has been applied in Canada

Table 2—Developed Water Power in Canada

Province	Turbine installation in h.p. in Central Stations	 in Pulp and Paper Mills	 in Other Industries	 Total	 Per 1,000 Population
1	2	3	4	5	6
British Columbia	207,656	48,800	48,859	305,315	584
Alberta	32,380		807	33,187	57
Saskatchewan					
Manitoba	93,355		10,792	104,147	170
Ontario	948,372	170,624	93,654	1,212,650	414
Quebec	696,593	224,412	94,380	1,015,385	432
New Brunswick	8,978	14,668	6,534	30,180	78
Nova Scotia	14,992	17,999	13,957	46,948	90
Prince Edward Is.	245		1,624	1,869	21
Yukon	10,000		3,199	13,199	3,170
Canada	2,012,571	476,503	273,806	2,762,880	315

Column 2 includes only hydro-electric stations which develop power for sale.

Column 3 includes only water power **actually developed** by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro power central stations totalled in column 2, 72,122 h.p. in Ontario and 88,455 h.p. in Quebec. The total hydro power utilized in the pulp and paper industry is therefore 637,080 h.p.

Column 4 includes only water power **actually developed** in connection with industries other than the central station and the pulp and paper industries. These industries also purchase blocks of power from the central stations totalled in column 2.

Column 5 totals all turbines and water wheels installed in Canada.

Column 6 averages the developed water power per 1000 population.

has been in connection with the central electric station industry. The extensive economic radius of modern electrical transmission, combined with the fortunate location of waterpower in relation to centres of industry, has resulted in the widespread development of the Dominion's water power resources through central electric stations. The extent of this industry and the important relationship which water power bears to it may be measured by the fact that 91 per cent of the prime motive power is water power and that there is now invested some $437,000,000 in hydro-electric plants and systems engaged in the production of electrical energy for sale and distribution.

Throughout the Dominion there are 282 hydro-electric stations with an installed turbine capacity of 2,013,000 h.p. or a generator installation of 1,701,000 kv.a. It is of interest to note that of the total turbine capacity, 1,449,000 h.p. is installed in commercial or privately owned stations, while 564,000 h.p. is installed in municipal or publicly owned stations.

The units vary in size from 10 h.p. to the 60,000 h.p. turbines just installed in the Queenston development of the Ontario Hydro-electric Power Commission and which are the largest water turbines anywhere installed at the date of writing. The turbine units in the industry average 3,077 h.p., while the average installation of the central stations is 7,137 h.p.

Continued and systematic progress is being made in the further development of the industry; new units are being installed, new plants constructed and new projects investigated having in view the necessity for meeting the growing domestic and industrial demand for cheap hydro-electric energy.

Water Power in the Pulp and Paper Industry

The manner in which water power has influenced and assisted in the development of the pulp and paper industry throughout the Dominion is demonstrated by the power statistics of the industry.

Cheap motive power is almost as important to the production of pulp and paper as is the abundant supply of raw material. The importance of cheap power lies in the fact it takes practically 100 horse power to make a ton of paper per day. It is not therefore surprising that motive power used in this industry is practically restricted to hydraulic energy and that Canada's premier position in the pulp and paper field rests on adequate and abundant water powers well distributed among extensive forest reserves.

Throughout the Dominion 113 mills, operated by water power, are engaged in the manufacture of pulp and paper using in all hydro energy to the extent of 637,000 h.p. This total is made up of 476,000 h.p. **actually installed** in pulp and paper mills plus 161,000 h.p. **purchased** by pulp and paper mills from central electric stations which derive their energy from water power.

The development of the electric drive in the pulp and paper industry has been marked in recent years. Its advantage lies in the fact that it assures a uniform speed of operation and that it permits the centralized operation of a large mill receiving power from several hydro-electric sources. This means the economic location of pulp and paper mills having due regard for source of pulpwood supply, source of power supply and availability for shipping product. Of the 476,000 h.p. actually installed in pulp and paper mills 179,000 is represented by hydro-electric drive. To this amount may be added the 161,000 h.p. of hydro-electric energy purchased from central electric stations, bringing the total electric drive up to 340,000 h.p.

Of the total installation listed, 5 mills are located in British Columbia utilizing 48,800 h.p., 41 in Ontario utilizing 242,700 h.p., 54 in Quebec utilizing 312,900 h.p., 3 in New Brunswick utilizing 14,700 h.p., 10 in Nova Scotia utilizing 18,000 h.p.

The systematic progress during the past few years in the pulp and paper industry is an indication of the rapid expansion which may be expected in the future.

Future Growth in Utilization of Water Power

It is profitable to consider the history of water power utilization in Canada during the past few years in conjunction with the present activity with a view to making some reasonable forecast as to its probable future growth. Should the rate of water wheel installation during the past fifteen years be maintained, there will be installed in 1925, 3,360,000 h.p.; in 1930, 4,110,000; in 1935, 4,860,000 h.p. and in 1940, 5,600,000 horse power. In view of the increasing appreciation of the advantages of hydro power combined with the fortunate location of ample supplies within easy transmission distance of practically every great industrial centre throughout the Dominion, there is every reason to anticipate that this rate of growth in utilization will be accelerated rather than retarded. Reference to the above totals of available power will indicate that this anticipated increase in utilization will not seriously reduce the total reserves. Canada possesses sufficient reserves of water power to meet all anticipated demands for many years to come.

In order to ensure the most beneficial utilization of these reserves and to provide intelligent guidance for their development, two essentials are required.—

1. An accurate knowledge of the location, capacity and the economic and engineering possibilities of development of the water powers throughout the Dominion, together with their relationship to other natural resources of mine and forest, to industrial centres and opportunities, to transportation systems, rail and navigation, to coal and fuel supplies, to irrigation, drainage and reclamation projects, to alternative sources of power and to market for and use of power in general.

2. A sound governmental administrative policy designed to protect the public from inadvisable and ill-designed power schemes and to provide for reasonable regulation and revision of rates and rentals, and at the same time to ensure satisfactory guarantees for the encouragement of legitimate investment in hydro power enterprises.

True conservation of our water power resources, which are inexhaustible through use, lies, not in withholding them from development, but in their efficient utilization in the public interest for the economic exploitation of our other natural resources, and for the conservation of our exhaustible fuel supplies.

The water power now developed in Canada represents an investment of $530,000,000. In 1940 should the rate of growth in installation during the past 15 years be continued, this investment will have grown to over $1,000,000,000. The present development represents an annual equivalent of 20,500,000 tons of coal which, valued at $8 per ton, represents $164,000,000. In the year 1940 these annual figures will, with the foregoing assumption, have become 42,000,000 tons and $336,000,000. These figures are striking evidence of the outstanding importance and necessity of an intelligent administrative policy governing the development of our water power resources.

Sound Proofing Walls and Partitions

Recent Investigations Show That It Is Possible to Insulate Rooms and Control Noise Transmission—Absorbtion of Sound an Essential Feature for Effective Results

The demand for quiet rooms in hospitals, hotels, and office buildings, the desirability of insulating music studios and other rooms where disturbing sounds are produced, and the necessity for solving other problems for the control of noise have led to repeated requests from architects and builders for reliable information on effective methods for insulating sound. Although present information on the subject is incomplete, Bulletin No. 127 of the Engineering Experiment Station of the University of Illinois, "Sound-Proof Partitions," by F. R. Watson, collects and presents the available information in a systematic way, giving the methods and results of various investigations relating to the action of materials on sound, describing practical installations of sound-proofing, and setting forth in accordance with existing knowledge recommendations that may be applied where sound insulation is wanted.

The conclusions and recommendations of the bulletin are summarized as follows:

Sound may be transmitted from one side of a partition to the other in three ways; it may progress through continuous air passages, it may pass as an elastic wave through the solid structure of the partition, or, by setting the partition in vibration, it may originate sound waves on the further side.

These actions are quite readily understood by remembering that sound consists of a series of compressions and rarefactions that progress rapidly through a medium without interruption unless they meet a new medium with a different elasticity or density. For instance, sound waves in air proceed without hindrance through air passages, such as ventilation openings in a partition. If, however, the passages are small in cross-section, as in the case of a porous material, the progress is hindered and a certain amount of absorption of the energy takes place, due to the friction set up between the vibrating air column and the sides of the pores.

In case the partition is impervious to air, the direct progress of the waves is interrupted. A thin partition is set in vibration and thus originates new waves on the side opposite the incident sound. For a thicker, more rigid partition, the vibrations are smaller and a very considerable part of the energy is reflected. The transmission in this case takes place by compressional waves communicated to the solid material of the partition. The amount of energy thus transmitted is usually quite small.

Rigidity and Freedom from Air Passages

In view of these considerations a sound-proof partition should be as rigid and free from air passages as possible. For effective sound-proofing of a group of rooms, the partitions, floors, and ceilings between adjacent rooms should be made continuous and rigid. Any necessary openings for pipes, ventilators, doors, and windows should be placed in outside or corridor walls where a leakage of sound will be less objectionable.

In case the sound is generated in the building structure, as the vibrations set up by a motor fastened to the floor, the compressional waves proceed through the continuity of solid materials. In order to stop them, it is necessary to make a break in the structure so as to interpose a new medium differing in elasticity and density. For instance, the vibrations of a motor may be minimized by placing a layer of hairfelt, or similar air-filled material, between the supporting base and the floor. Where the machine is quite heavy, footings may be made of alternate layers of asbestos, lead, and leather. Bolting through this material will reduce the insulation, because the vibrations in this case will pass easily through the bolts to the floor. The insulation should thus be left without any bridging over of the discontinuities. Air gaps in masonry will be effective if the air space is not bridged over at any point. A floor floated on sand, sawdust, or hairfelt would approximate this condition. The edges of the floor should be insulated from the walls by felt or similar material.

The Ventilation System

Especial attention should be paid to the ventilation system. All effective sound-proof constructions either omit entirely a ventilation system or else construct it in some special manner to avoid transmission of sound. In some buildings air is supplied and withdrawn from rooms by individual pipes that are small in diameter and extend without break from the air supply chamber to the rooms. This results in considerable friction between the walls of the pipes and the air, with a resultant weakening of the sound waves. Without some efficient control of the transference of sound through the ventilation system it is a waste of effort to construct sound-proof walls, double doors, and other contrivances for insulation.

When soundproofing a building all details should be considered with respect to the likelihood of transmission of sound. Each room, as far as possible, should be made an insulate unit by means of air spaces or air-filled materials that separate it from surrounding walls. Pipes and ventilators should be so installed as to minimize the chance of transfer of sound.

The absorption of sound is an essential feature for sound-proofing. Reflecting sound and scattering it still leaves it with energy. It must be absorbed; that is, converted into heat energy by friction, before it is eliminated as sound. This means that carpets, furniture, draperies, etc., should be present, or if greater absorption is desired, hairfelt or similar materials must be installed.

The insulation of sound is a complex problem and a successful solution is obtained only when all the possibilities of transfer of sound are anticipated and guarded against. While many things may be learned from further experience and much may be gained from additional theory, enough has been revealed to give encouragement to the belief that soundproofing may be prescribed in the future with some of the certainty that now attends the acoustic design of auditoriums.

Second floor column forms in place on new hospital at Victoria, B.C.

New hospital at Victoria from the south-east, showing concrete handling plant

Progress on Provincial Royal Jubilee Hospital at Victoria, B. C.

Contractors are Proceeding Rapidly With Concreting Operations of New East Wing—Details of Mixing Plant—Concrete for Cornice Instead of Stone Saves Cost

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Since the danger of severe frost passed a few weeks ago. splendid progress has been made on the construction of the new east wing for the Royal Jubilee Hospital at Victoria, B. C. The contractors, Messrs. Parfitt Bros. of Victoria, have reached the second floor with form work and are, at the time of writing, erecting column forms on that floor, while the columns of this floor are already being poured on the whole of the northern section, beam and slab forms being also in place. The ground floor columns have already been stripped and show an excellent quality of work.

The concrete is being mixed and handled from a central mixing plant, located in the L formed by the east and south wings of the building. The mixer is at ground level, and stock piles of gravel and sand are deposited on platforms of sufficient height to give gravity feed to the mixer. These platforms are provided with ramps so that trucks coming in with gravel can run up and dump, thus eliminating manual labor as much as possible. The perhaps more usual practice of locating the mixer below ground level was impracticable in this case, as the building has no basement and the entire site is solid rock. A contractor's elevator of ordinary pattern, with two cages, handles the mixed concrete to the different floors, and a separate lift is provided for handling forms and steel. Both are operated by electric motor.

Large Plumbing Contract

Work on the plumbing contract is also in full swing, and the contractors, Messrs. Thacker and Holt, have a good deal of the roughing-in material on the ground already. This is one of the largest plumbing jobs let on the Coast for some time, totalling $62,000. in value including the heating. Provision is being made for 100 plumbing fixtures and 9,000 feet of radiation. All pipes below the ground floor run along the walls of tunnels excavated in the rock for the purpose, and are carried on expansion hangers. Branch pipes to stacks are carried from the tunnels in the space left between the excavation level and the bottom of the floor slab, 18 inches clear.

Mention was made in a previous article (Contract Record, February 15, 1922, page 147) of the margin between the prices tendered by the contractors for the concrete work, Messrs. Parfitt Bros., and their next lowest competitors. This was given as amounting to $20,000.00 and is on the surface, an unreasonable amount in a contract of this size. The main portion of the difference, however, is accounted for by an alternative proposed by Messrs. Parfitt Bros., in their tender, and accepted by the Hospital Board. The plans as issued provided for a cut stone cornice of heavy construction at the roof level, and surrounding the building. The alternative proposal was to construct this cornice in reinforced concrete, the difference being in the neighborhood of $15,000.00.

The architects for the building are Messrs. P. L. James and K. B. Spurgin, of Victoria, B. C.

The Hardinge Co., New York, N. Y., have issued their catalogue No. 12. entitled "Quigley Fuel Systems". These systems comprise a complete method of pulverizing, transporting and burning pulverized fuel in many manufacturing operations for which such fuel can be satisfactorily employed. The extent to which pulverized fuel is capable of being used is indicated in the catalogue, which completely illustrates and describes the equipment that goes to make up the Quigley systems.

"Distant Control" of Municipal Engineering Projects

How a City Engineer, Through a System of Daily Reports, May Keep in Touch With the Job—Application of the System to Asphalt Paving

By **W. EARL WEBBER**
City Engineer, Binghamton, N.Y.

Prepared for use as a circular to be issued by the Asphalt Association

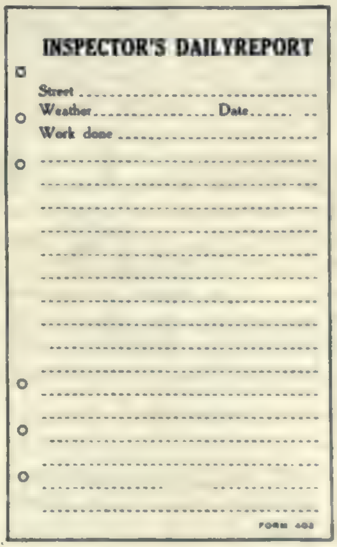
Engineers charged with the responsibility for the construction of public work many times find themselves unable, because of various inroads on their time, to visit the individual jobs as frequently as the work really requires. This means either neglect of the work or the installation of some system of "distant control" as an electrical engineer would term it. Fortunately a very complete system of such control requires only a small expenditure of time, energy or money; in fact, a well devised and strictly enforced system of "daily reports" properly used will satisfy all demands.

The daily report has long been the ever-present help of engineers occupying executive positions in private corporations, but the tendency, unfortunately, in public work has been to dismiss the report as a useless bit of red tape. In reality a system of daily reports has three distinct values. First—The necessity of preparing a daily report that will be read has a decided effect in holding an inspector closer to his job. Second—When the work is complete the daily reports form an invaluable record of the job. The profession of contracting has its share of constituent members having such common human failings as inefficiency and dishonesty. Sooner or later every engineer will meet a contractor endowed with one or both of these failings. At such a time the record comes into its own and demonstrates its worth. Third—Daily reports, received and considered not later than the morning of the day following the one covered by the report, keep the engineer in touch with the work each day no matter how the individual jobs may be scattered, thus making it possible for him to follow the progress of the work, to check the ability of his inspectors and to determine just where the time at his disposal for visiting the work shall be spent. This last is "distant control."

No type of construction work lends itself so readily to such control as the asphalt pavement and municipal engineers who have spent weary hours either searching for or trying to develop capable asphalt inspectors will add, perhaps, that no type of construction work stands so much in need of such control. The Bureau of Engineering in Binghamton, New York, has used for the past three years a system of daily reports in connection with its construction work. These reports have amply proven their value in the light of actual use and the following brief description of the system as applied to asphalt construction is offered in the hope that it may be of value to municipal engineers.

Inspector at the Plant

Whenever asphalt work is in progress in Binghamton at least one inspector is on duty at the plant. This inspector is required to file a daily report including certain specific and certain general information regarding the day's run. For instance, he is required to take at hourly intervals the temperature of the asphaltic cement in the melting kettles and to note these temperatures in his report. He also notes on his initial report the mixing formula used by the contractor and on subsequent reports indicates any change in this formula. Two other items of specific information must be furnished by the plant inspector on each daily report, the total run of the plant in tons and a statement of all materials received. He is at liberty, in fact is encouraged, to report any item of general interest in regard to the plant operation, such as the force employed, accidents to employees or to the plant and general observations concerning operating efficiency. He must report back to the office on his daily report any orders which he may have received during the day. This feature of the report has been especially valuable both in fixing responsibility and in assuring the engineer in charge that his instructions are understood. All this information is recorded on Form 402 (See Figs. 1 and 2). This report must be filed in the city engineer's office not later than nine o'clock in the morning of the following day. In addition to the things the plant inspector must do in order to render a satisfactory report he also takes samples of all materials received

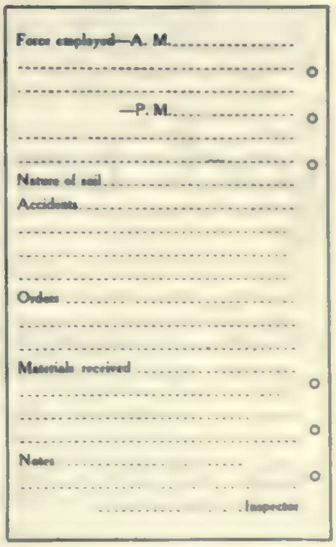


INSPECTOR'S DAILYREPORT

Street ....
Weather .... Date ....
Work done ....

FORM 402

Fig 1



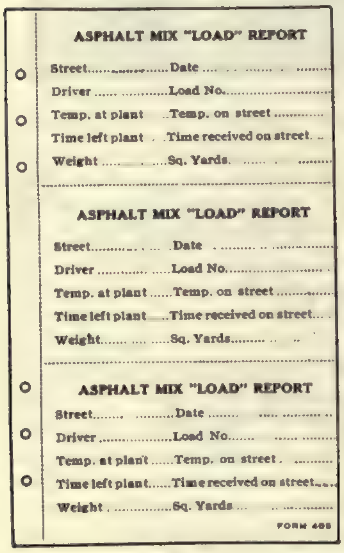
Force employed—A. M. ....
—P. M. ....
Nature of soil ....
Accidents ....
Orders ....
Materials received ....
Notes ....
.... Inspector

Fig. 4

Fig. 1—Inspector's daily report form (front of sheet)
Fig. 2—Inspector's daily report form (back of sheet)

and makes such simple plant tests as may be required to keep the mix fairly uniform. At times it has been found advisable to have two inspectors at the plant, one spending all his time on the mixing platform. The samples taken by the inspector include a daily sample of the asphaltic cement taken the first thing each morning from the kettles.

Every load of "mix" leaving the plant must be accompanied by a consecutively numbered load report (See Fig. 3) signed by the plant inspector. These reports are made in triplicate by the inspector who notes thereon the number, destination, temperature and weight of the load and the time it left the plant.



ASPHALT MIX "LOAD" REPORT

Street.................Date..................
Driver.................Load No...............
Temp. at plant.........Temp. on street.......
Time left plant........Time received on street........
Weight.................Sq. Yards.............

ASPHALT MIX "LOAD" REPORT

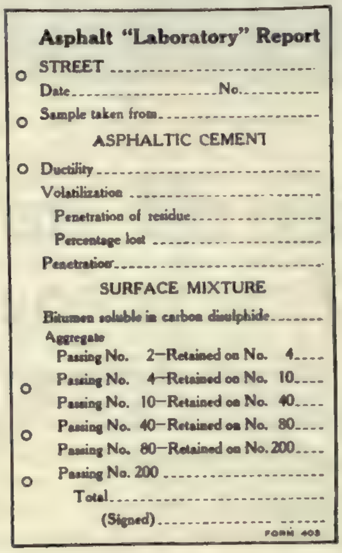
Street.................Date..................
Driver.................Load No...............
Temp. at plant.........Temp. on street.......
Time left plant........Time received on street........
Weight.................Sq. Yards.............

ASPHALT MIX "LOAD" REPORT

Street.................Date..................
Driver.................Load No...............
Temp. at plant.........Temp. on street.......
Time left plant........Time received on street........
Weight.................Sq. Yards.............

FORM 403

Fig. 3



Asphalt "Laboratory" Report

STREET ----------------------------
Date--------------------No.----------
Sample taken from-------------------

ASPHALTIC CEMENT

Ductility---------------------------
Volatilization----------------------
Penetration of residue--------------
Percentage lost---------------------
Penetration-------------------------

SURFACE MIXTURE

Bitumen soluble in carbon disulphide-------
Aggregate
Passing No. 2—Retained on No. 4----
Passing No. 4—Retained on No. 10----
Passing No. 10—Retained on No. 40----
Passing No. 40—Retained on No. 80----
Passing No. 80—Retained on No. 200----
Passing No. 200 ---------------------
Total-------------------------------
(Signed)----------------------------

FORM 403

Fig. 4

Fig. 3—Load Report form
Fig. 4—Asphalt laboratory report form

One of these reports is given to the driver of the truck or wagon, the second is given to the plant foreman and the third is retained by the inspector. When the load arrives on the street the driver must deliver to the city inspector on the street his copy of the load report. The temperature of the mix is again taken and, if this temperature is satisfactory, the load is dumped. The inspector then notes on the copy of the load report given him by the driver the temperature as determined on the street, the time the load was received and roughly the number of square yards the load was made to cover. The plant inspector sends his copies of the load reports to the office with his daily report and the street inspector does the same with the copies that he has received from the drivers.

Duties of the Street Inspector

The street inspector is required to submit a daily report covering the work done ,the force employed and the materials received on the job. The work done must be so described, that, should it be necessary, the work of any half day can be located both on the street and in the plant reports. This result is obtained by describing the work by stations which have been chalked on the curb at regular and frequent intervals by the engineer in charge and by designating by load numbers the mix used in each section. The street inspector is also required to show on his report a fairly close estimate of the yardage of top placed during each half day and to give, as in the case of the plant inspector, a brief synopsis of any and all orders that he may receive. He is also required to take at least two samples each day of the mixture as received on the street and to indicate very carefully the exact locations in the street and the numbers of the loads from which these samples were taken. The daily reports of the street inspector must be filed in the city engineer's office not later than nine o'clock of the morning following the day covered by that report.

The samples of the asphaltic cement and of the surface mixture as taken by the inspector are delivered by the engineer in charge of the work to the city chemist for analysis. These analyses are made immediately and the results reported to the city engineer on the "Asphalt Laboratory Report" (See Fig. 4).

In the office the load reports from the plant are checked against the load reports from the street and then destroyed. The load reports from the street are then considered, temperatures being noted first. Any load leaving the plant too hot or received on the street too cold is listed for comment. The tonnage for the day is compiled next and checked against the daily report of the inspector at the plant. Any discrepancy calls for an explanation. The tonnage of mix used is then divided by the total yardage reported by the street inspector on his daily report. The result must at least be equal to a previously determined weight per square yard. A discrepancy in this results in a "riot call" for contractor, inspectors and engineer-in-charge and just must be explained or rectified. The recorded temperatures of the asphaltic cement are rapidly considered for any evidence of overheating and the laboratory reports checked over as to grading of mix and amount and quality of asphaltic cement. These things can all be done by the secretary if the city engineer or the deputy engineer are busy and only the variations noted. The remainder of the daily reports are read very carefully and any job that seems to need personal attention is visited during the afternoon.

All of the forms used for the above reports are uniform in size and as simple as possible. This uniformity of size is applied to specifications, extra work orders and extra work reports, thus making it possible for the inspector to keep all his data and reports between the covers of a single binder. All forms are made 3¾ in. by 6¾ in. in size—a real pocket size—and are punched for use in ring binders. Field reports are printed on pale blue and laboratory reports on a light orange paper. When the job is complete all daily reports, field notes, written orders, extra work reports, construction records and estimates are bound together in an inexpensive binder and filed away to form the office history of the job. It is surprising how many times these "histories" are needed for reference.

A Practical System

Attention is called to the fact that the system above described is not academic but rather is eminently practical and that it has stood the test of three years' exacting use without any serious change in the system or in the forms. It is not to be understood that this system will supply ability that may be lacking in inspectors. No report can possibly tell how well the requirements of the specifications as to how material is to be handled or as to the way of raking are carried out. The system will, however, from its very nature tend to increase the inspector's interest in and application to his job. It is sometimes objected that such a system requires too much time.

Contract Bonds for Construction Work

The Fourth Article of a Series Discusses Why Bond Companies in Certain Instances Demand Collateral Security From a Contractor—Good Name Usually Sufficient

By A. E. KIRKPATRICK
General Manager, United States Fidelity & Guaranty Co., Toronto.

One of the most difficult things for a layman to understand is why it happens that in certain unusual cases a bond company not only charges a premium but also insists on collateral security being deposited with it for its protection.

It should first be clearly understood that collateral security is not demanded except in exceptional cases. Ninety per cent of all contract bonds are written without any other security being asked of the contractor than his good name and undertaking. There are exceptional cases, however, and when these cases arise, it is well that the contractor and his bond company fully and mutually understand the reasons therefor, because as stated in a previous article, mutual confidence and understanding is the very fundamental basis of all dealings between the contractor and his bond company.

There are certain classes of work, where the physical hazards are such that the best constructional ability is more or less subordinated to the element of luck or chance. There are also cases when a contractor, for personal reasons, feels obligated to bid on work when he has all the work on hand he can comfortably handle—where the owner practically insists on his bidding for the work; these and other reasons may be the basic cause, but whatever the cause is, the bond company in asking for collateral is only trying to stretch its line of credit to suit the convenience of the contractor. And as in case of loss it must pay, it must be the judge as to when collateral is necessary.

A bond company is the trusted repository of the innermost secrets of thousands of men and can safely be trusted to act as the depository of securities as well. In its hands they are safe—interest as it accrues is credited to the contractor who owns the securities and most important of all, in case of dispute arising between the contractor and the owner, no one but the contractor knows of the deposit of collateral and the bond company will see to it that the contractor's interests are as carefully guarded as the owners'.

The bond company is a fair and judicial umpire and pays its just obligations without question, but will insist absolutely that both the contractor and the owner each carry out their obligations to the letter—each to the other. Owners have been known to be overbearing, not often but sometimes it has happened that possession has proven to be nine points of the law, because at the critical time of argument, death, disability or financial distress has undermined the resistance or honest convictions of the contractor and impaired his ability to demand and procure a square deal.

The bond company does not die, it does not fall ill or suffer inefficiency through the disabilities to which frail flesh is heir, and for these reasons alone an honest contractor's collateral in the hands of a bond company in the rare exceptions where it is needed is as safe as if in his own safe deposit box, and he has a sure friend to stand between him and unreasonable or dishonest demands.

Artificial Ice System Converted Into Heating Plant

The Necessity for Heating the Arena Skating Rink, Vancouver, in an Emergency Caused the Introduction of a Novel Method of Using the Ice Making Apparatus

When Mme. Galli-Curci sang in Vancouver on March 29th the only auditorium of sufficiently large proportions to accommodate the expected audience was the Arena skating rink. Vancouver is the place where they have to make artificial ice for their skating rink, even in winter. But the cold storage atmosphere was not conducive to the best efforts of even a prima donna, to say nothing of the comfort of the audience. It was, therefore, decided to heat the Arena. The idea was to reverse the usual process by which the ice on the skating floor was formed. So the problem was put up to the engineering department of the B. C. Electric Railway Company. Here is how they solved it, the installation and test being completed in forty-eight hours—incidentally it is the first time on record when such a method of heating electrically was ever tried. The results were entirely satisfactory, the large audience which packed the great Arena enjoying the concert with all the comfort of a theatre.

The circulating pipes for the artificial ice system are installed in parallel lines between parallel headers laid in sand under a hardwood floor, on which the ice film is ordinarily formed. There are 53,500 feet of this pipe, which is 1¼ inches in diameter. To heat these coils the method adopted was as follows:

Three sections of ¾ in. pipe, 250 feet long, were coupled in delta and immersed in the 25,000 gallon brine tank. After being heated to pre-determined value, the water was circulated by a 600 gal. centrifugal pump. Elements were supplied by a 650 kw. transformer, 2200/110 volts, coupled in parallel delta, the current on the 2,200 volt side being 90 amperes.

After heating the tank water for twenty-four hours, the temperature of the water in the tank was raised in that time to 160 deg. F. and then circulated by means of the pump through the pipe system for three hours. The following figures show the result:

Before circulating: Temp. of tank water, 160 deg.; temp. of floor, 49 deg.; temp. outside bldg., 43 deg.;

After circulating 3 hours: Temp. of tank water, 106 deg.; temp. of floor, 59 deg.; temp. outside bldg., 41 deg.

During the 30 hours' run in which the temporary heating plant was used, the power required was 9,000 kw. hours. To give a more definite idea of the heating problem solved in this original manner, the following dimensions are furnished:

Height of building	60 feet
Width of building	135 feet
Length of building	260 feet
Area of exposed walls	47,400 sq. ft.
Brine tank capacity	25,000 gals.
Piping system capacity	5,000 gals.
Lin. ft. pipe under main floor	53,500 ft.
Size of pipe	1¼ in.

Lack of Uniformity in Building Codes

Few of Those in Force are Drafted With a View to Encouraging a Good Class of Building

By DUDLEY F. HOLTMAN
Construction Engineer, National Lumber Manufacturers Assn.

Before National Construction Conference Chicago, April 15

Among the most chaotic conditions confronting the building industry a few years ago—and the condition exists to a large extent at the present time—was the lack of uniformity in building codes and the absurdity and impracticability of a large portion of their provisions. That the lumber industry was alive to the seriousness of the situation is attested by the widespread effort it has made to improve it. I believe no greater field of service exists than the stimulation of intelligent interest and effort looking toward the standardization of building codes. The problem is a big one. It is a problem that requires a correct statement of principle and a sober working out of the just and proper solution. Certainly, if ever there was a time when men should make every effort to reduce construction costs, so that the average citizen with a moderate sized pocket book could provide adequate shelter for his family, it is now.

During the past two years we have made a thorough field survey of building code conditions in every city of any importance. Our field representatives have devoted all of their time to this work and we now have in our files up-to-date accurate information, relative to the status of building ordinance legislation in practically every city with a population of over 5,000. There are very few exceptions. The information that we have obtained is kept up-to-date by means of a well-organized system of correspondence, so that our files show the current status of code activities in all of these cities and an examination of the large map hanging in our office covered with various colored pins indicates the general state of building code activities throughout the country at a glance. I think our method of procedure has been sound. We might have spent our time in work with a few of the most representative cities, but if we had done that we would not have the detailed, comprehensive knowledge of the building code situation of the country that our general survey—or reconnaissance—has given us.

Poor Building Code Restricts Construction

Industries and building investments cannot proceed until all forms of cost inflation, which have loaded it with unnecessary capitalization charges, are removed. We must face the situation squarely. We must put aside all thoughts of special interest or privilege and prepare our building codes on the basis of a well-recognized minimum requirement. Investors are calling for this and waiting for it. The public are demanding it. A well prepared building law will do much to insure prompt investment in building. A poorly prepared building law, full of unwise and unnecessary restrictions, may so handicap building construction as to put a blight on the growth and prosperity of the community. Every building law should be considered as a building service for the protection of the owners and occupants of buildings and as an assistance to builders, rather than as a restriction imposed upon them. It should serve as an infallible guide to the minimum expense consistent with safety and dependability of building construction. For this purpose it should be sufficiently flexible to allow for individuality and selection and for efficiency and for changing conditions. If this is done it will allow sufficient competition to keep costs at a minimum for all forms of construction.

There is nothing that so handicaps the builder in his continual effort to keep construction costs reasonable as legislation framed and administered to require expensive or troublesome construction and there is nothing that so effectively prevents the development and use of new forms of construction. All restriction of the freedom and choice of the builder and owner, without logical necessity to preserve the dependability of construction, has a cumulative effect upon the cost of construction. No building law should bar any safe and dependable form of construction.

The lack of ordinances regulating construction in the majority of the cities is astonishing. Most communities, I suppose, have the feeling that it is folly to undertake work of this kind unless they are pretty sure they will be able to finish it, for half finished work usually proves to be labour lost. There cannot justly be any objections to having up-to-date workable building codes any more than there is objection to having other good things, provided they cost nothing. The principal reason for the present lack of proper regulatory measures is their expense and in many cases the objection to paying for work of this kind arises largely from the want of ability to pay.

Very Few Properly Prepared Ordinances

Our information indicates that only 27 per cent of cities with a population of 5,000 or over have a building law, and in all probability twenty or more of these laws are included as a part of the original city charter. Other cities claiming codes have what is merely a set of restrictions specifying the area known as the "fire limits". In the majority of cases, where fire limit restrictions only prevail, the ordinance merely specifies the area included within such limits and requires that the buildings erected therein shall have incombustible walls and roofs. They make no restrictions as to the allowable heights of buildings. They say nothing about maximum areas between fire walls nor do they mention the character of interior construction. Any kind of a fire-trap interior may be constructed and it may cover any area as long as the exterior walls are masonry walls and the roofs supposedly incombustible. In all probability these kinds of laws are the only ones in effect in 65 per cent of cities.

There are 259 cities, in the U. S., with a population of over 25,000 and only 223, or 80 per cent, of these cities give evidence of having a building code. Thirteen of these cities have codes with no enforcing officer, while 23 cities have no code whatever but do have a building inspector. Of the 460 cities with a population of from 10,000 to 25,000, only 116, or 25 per cent, have a building law, and 26 of these have no officer to enforce it. Of the total of 739 cities with a population ranging between 5,000 and 10,000, only 81, or 9 per cent, have building laws, and 25 of these cities have no means of enforcing the law.

A number of the cities which have codes have no copies available for the use of the public or for the use of builders and architects. Some of these regulations are hidden away in the minutes of the council meetings. A man who erects a building, or who has the supervision of the construction of a building in hand, must delve through musty records to determine what regulations he is expected to comply with.

It is very evident that the preparation and the enforcement of a building law is a specialty. It is a matter of such importance that the work should not be entrusted to any inexperienced or improperly constituted body. Experience during recent years indicates that building codes, in order to be most beneficial, must undergo frequent amendment and addition. Methods and materials of construction and the uses to which buildings are put are constantly changing. New economic conditions bring about new kinds of buildings and in any case there are a great number of minor contingencies for which it is impossible to provide in any ordinance. It has been found desirable, therefore, that the official in charge of building legislation be given the power to formulate and publish rulings elaborating upon the building code as enacted by the legislative body of the city.

A Building Code is a Compromise

A building code is intended to be a statement of the economic requirements as to quality of materials, grade of workmanship and methods of design which are necessary to make buildings safe, durable and otherwise satisfactory. A building code should not be too definite and detailed in its provisions lest it lose a part of its possibilities for good and unduly hamper private initiative and enterprise. In effect, therefore, such an ordinance usually is a compromise between the necessity of telling the public what is required of it, and of having a brief, flexible document for purposes of administration. Any building code represents the compromise at which its writers arrive at with regard to these two questions.

The lumber industry welcomes open competition. With the aid of certain fire prevention enthusiasts, "substitute" material manufacturers make an effort to legislate lumber out of markets where, as a material, it has a just claim for recognition. It is this kind of "competition by legislation" which the lumber industry finds particularly obnoxious and which it intends to make every effort to have stopped. Every material has its advantages and disadvantages and in the long run no propaganda can overcome the truth.

In my judgment it is not necessary to tell intelligent people that wood will burn. It is also pretty generally known that any residence (except a tomb) is liable to destruction by fire. There are many safeguards which can be used in all kinds of building construction and slow burning construction is just as possible when wood is used as when other materials are used. There is a tendency, as a city grows, to enlarge the fire limits of that city until those limits extend way out into the suburban districts. The citizens owning a lot anywhere within those limits must either build "fireproof" or not build at all. The result is a great deal of undeveloped property. We might just as well recognize the fact that cost is an important element entering into the calculations which any prospective home owner makes. He should be encouraged to improve his property and he should be given an opportunity to build any kind of a house that he wants to as long as it meets with the ideas which the community entertains with respect to fire hazards. Tests have been made and are being made by the lumber manufacturers of the country, in co-operation with other manufacturing interests, which clearly indicate that certain types of construction, of which wood is the frame work, offer a resistance to attack by fire quite sufficient to protect them from any ordinary exposure hazard. These constructions should be recognized by city officials when they revise their codes.

The time has come when we must undertake to do everything that we can to encourage the salaried man to build and we must encourage him by offering him every inducement to "start something". This we can do in large measure by revising those antiquated, obsolete building ordinances which require him—if he builds now—to build nothing less than a "tomb" to meet all of the unnecessary restrictions imposed upon him by those enthusiastic elements of society whose battle cry is "fire".

Practical Experiences in Concrete Road Construction

By A Contractor

In the matter of construction joints: we are convinced that the time of the year when the road is constructed has some bearing on the matter. It has been determined to leave out all the joints in the highways to be constructed during July and August of next year. We believe that concrete built during the summer is much less liable to expand than that built either earlier or later in the season.

We are going to try out ten or twenty miles with a center joint, largely with the idea that it will act as a divider of traffic, as we are still to be convinced of the necesssity of splitting a road in two merely to prevent cracking, when a large share of the roads do not crack longitudinally.

Regarding reinforcement: We will continue to reinforce transversely with approximately ½-in. rods, spaced 4 ft. or 5 ft. apart. The length of these rods will be about three-fourths of the width of the road. They will be staggered so that the center of the pavement will have more reinforcement than the edges.

This reinforcement will be placed in wet cuts, as it has been our custom in the past couple of years, and also in fills where there is an old core which has been widened.

For longitudinal reinforcement we are going to try ten to twenty miles with one heavy rod on each outer edge to reinforce against breakage by heavy truck hauling. Because of the reasonably small amount of breaking of corners that we have had, we somewhat doubt the economy of adopting a 100 per cent longitudinal reinforcement along the edges.

Regarding proportions: We expect to make some rather radical changes. Our sands vary from some that about equal standard Ottawa strength to others as high as 180 per cent, or higher than the standard Ottawa strength. Obviously it is not fair to use the same mortar with all these sands. We therefore expect to vary the proportion of our mixture somewhat in accordance with the strength attained by the sand mortars. In other words, we know we are getting out better concrete with the very high grade sands than we are with the ordinary sands. Whether or not we will try to make the low grade sands into a richer mortar or whether we will lighten up a little on the cement content with the better sands we have not decided.

Regarding central mixing plants: We do not desire to see any more of them. We have very few of them, and in most cases they have been unsatisfactory. We believe we can get a better concrete of more uniform texture by mixing the material on the road.

One thing on which we do not agree with some ot our neighbors is the placing of material on the subgrade. We by no means will bar the use of the old wheelbarrow method of constructing pavements from materials previously placed on the subgrade. We believe that with regular inspection, such as concrete roads are supposed to get, the amount of material that will get into the surface from the subgrade will be a very minor quantity. In fact, in our past years' experiences we have had very little trouble from this source. We have had occasional jobs where some subgrade material did get into the mixture, but on the other hand we have also had a considerable number of jobs where material from the bottom of stock piles and out of cars and from other sources also got into the concrete.

There is undoubtedly a little more material wasted by dumping on the subgrade, but at the prices we pay in Wisconsin we do not think this is as serious a proposition as adding more cost to the pavement in more expensive methods. We believe with the present labor market and the present price of materials, we can build roads cheaper for the public with the old wheelbarrow method than we can in many cases with the more expensive equipment. We have carried on several day labor operations the past season, and have observed many of our contractors, and we still believe that there will be a large number of wheelbarrow outfits run in 1922 and in future years.

We believe there is an economic limit in the construction of concrete roads. It is somewhat like building a house; the better the house, the better we like it. But sometimes the better the house, the more our pocketbook suffers. So it is with the concrete roads. We must choose the roads that will be reasonably satisfactory to the travelling public, and not go too far beyond that in refinement. There is no doubt that heavy reinforcement, thicker roads, wider roads, higher priced materials, etc., would make better concrete highways. Whether or not we are justified in adopting these is a very great economic question. We believe our roads in Wisconsin are giving fairly good satisfaction, and we are attempting to hold them down to an economic basis.

Regarding finishing machines. Most of our engineers are dissatisfied with their use, especially where joints are being placed in the road or where the road is on a grade of more than 4 per cent. While we will not bar the finishing machines for the coming season, we will not encourage them. Our reason for not barring them is that we believe a machine may be invented which is not detrimental to the riding qualities of the road, and we would not care to bar one that would give good satisfaction.—From "Concrete."

Open Shop for Montreal

At a recent meeting of the board of directors of the Montreal Builders' Exchange, the open shop principle was emphatically declared for. It was decided that neither the international nor the catholic and national unions should be recognized. Under this decision it is left open to any contracting firm which is a member of the Builders' Exchange to make its own arrangement as to terms of employment, wages and working conditions and to bargain with employees as it sees fit.

Officers of the Constructive Mechanical Trades Exchange of Halifax

At the ninth annual meeting of the Constructive Mechanical Trades Exchange of Halifax, held on March 30, the following officers were elected for the ensuing year:

Hon. President—S. M. Brookfield.

President—A. A. McDonald.

Vice President—M. E. Keefe.

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A. A. McDonald

Making Road Building an Exact Science Through Research Work

Experimental Investigations Are Being Carried Out to Provide a Basis for the Sound Engineering Design of Highways — Effect of Impact, Moisture, Drainage and Soil Conditions

By A. T. GOLDBECK
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Before Congress of American Road Builders' Association

Any engineering project involving enormous expenditures must be based on sound engineering principles, else the full proportion of those expenditures will not yield returns, for human judgment is not infallible and without adequate knowledge mistakes are made. Mistakes in policy and errors in design have led to disproportionate road revenues in the past, and with the undoubted evidence before us of necessity for huge investments in highways in the future, we would be extremely unwise did we not gain every possible bit of definite and scientific information which will lead us to sound engineering design and give us the basis for sound engineering judgment. At the present time we are lacking in far too many items of cold scientific knowledge, and efforts are being made by the Bureau of Public Roads, by several highway commissions and by other agencies to gain the lacking information at the earliest possible date. The possession of this information means a saving for the taxpayer of tremendous sums of money. That alone is sufficient reason for the increasing interest in investigations, research, tests and inquiries into the problems of highway design and highway construction.

In planning researches of the Bureau of Public Roads we have had very definitly in mind that when our researches are completed we should have information which will lead to the rational design of road systems which will serve traffic with the utmost economy.

Highways Merely a Part of the Transportation System

It should be emphasized that our roads should be planned not merely to sustain the traffic without premature failure, but that they should be regarded as merely an essential part of a system of highway transportation, just as a railroad track is merely a part of a railroad transportation system. The roads and the vehicles travelling over the roads should be so suited to one another, not that the road surface will be most conserved, and not that the vehicles will be able to travel over them with the least possible vehicle cost, but that ultimate transportation economy will result. In other words, we have in mind that after all, our main object should be to accomplish highway transportation with the least cost to the general public who are paying for all the items of vehicle cost and highway cost involved in that transportation. This is a most important thought and I wish to lay special emphasis on it.

It will be readily understood that the maximum economy in highway transportation will only be possible after sufficient basic facts have been obtained to enable the highway engineer to say definitely that here is the proper design for a definite set of conditions at hand. Unfortunately this basic knowledge is lacking in many important branches of highway engineering, and we have undertaken as a starting point of our investigations a series of researches bearing on the structural design of highways.

A highway pavement must be regarded as a structure acted upon by forces and just as susceptible to the principles of mechanics, although perhaps more highly complicated mechanics, as a bridge structure. A little reflection will show that all pavements may roughly be divided into slabs of a rigid and of a non-rigid type, with a shading of one into the other. Thus, concrete and grouted brick on a concrete base are of the rigid type; sand-clay and gravel of the non-rigid type, and bituminous pavements, although at times of the non-rigid type are at other times capable of resisting some bending. The scope of our experiments has been outlined in such a way that we hope to be led into rational pavement design through the establishment of the fundamental facts.

Loads on the Pavement

One of the first thoughts that struck us was, what are the loads for which a pavement must be designed? If the traffic did not move there would be a comparatively simple answer to this question, for then all we would have to do would be to use the known weights and wheel loads of the different sized vehicles. But traffic moves, and in some cases with very high velocity, and although we are approaching the ideal of smoothness on our road surfaces, nevertheless, they are still somewhat wavy and somewhat rough, with the result that there is vertical motion of the vehicles with respect to the road, and impact is thus produced by traffic on the road surface.

We have made a very extensive series of investigations on the impact of motor vehicles of different sizes equipped with different kinds of special wheels and tires and running at variable speeds. We have fairly well established how much force is to be expected from the different classes of vehicles, and from this we can conclude to a certain degree what might be the relative destructive effect of these different vehicles.

Let me recall to your minds the somewhat approximate method by which we have obtained our results. The method consisted of placing an annealed copper cylinder under the plunger of a hydraulic jack which was set below the road surface. The motor trucks were permitted to fall upon this jack when running at different speeds and falling from different heights, and they thus delivered impact to the road surface or rather to the hydraulic jack in the road surface under known conditions. The impact flattened the copper cylinder and an exactly identical cylinder was placed in a testing machine and the pressure required to flatten it an identical amount was obtained. In this way we were able to express the blow delivered by the motor vehicle in terms of pressure required to flatten the copper cylinder under the blow. Although this was approximate, by further investigations we have been able to determine very closely the error involved in this type of measurement.

Impact Effects

Let us look at a few typical results showing the high spots of this investigation. There is a well established law of mechanics that force is equal to mass times acceleration. This simply means that if a body is in motion and is brought to rest, the more suddenly that is accomplished the greater will be the force necessary. If a steel sledge hammer strikes a steel anvil, the sledge hammer is brought to rest almost instantly, and there is tremendous force delivered between the sledge hammer and the anvil. On the other hand, if the sledge hammer were shod with a cushion of rubber a very much longer time would be necessary to bring it to rest, and the pressure on the anvil would be very much smaller.

What effect has speed on impact? In general, there is a very definite increase in impact with the speed of the vehicle, but in view of the variables of the truck design and tire equipment as well as kind and degree of roughness of the road surface, there is no definite law of increasing impact with speed, yet speed is a very important factor in impact. However, because the lighter trucks move at a very greater speed than the heavier trucks, the impact delivered by light trucks running at their maximum speed may be as high as that of heavy trucks at their maximum speed. Results are not yet available, though, to show whether or not this would mean equal destruction on the part of the heavy and light trucks at their maximum speeds.

What effect has weight of trucks on impact? This depends to some extent on the design of the truck. Thus, of two trucks of equal weight, one having four wheels and the other having six wheels, the weight on the wheels of the 4-wheeled truck would be heavier than that of the 6-wheeled truck and this would greatly increase the impact. Then too, trucks differ with respect to their distribution of sprung and unsprung weight and it seems to be established that light unsprung weight, that is light weight beneath the springs, has the effect of decreasing the impact on the road surface. In general, however, for like speeds the heavier the truck the heavier becomes the impact on the road surface.

Effect of Tires

What effect have tires? Tires have a most important effect, depending upon their cushioning properties. This is self-evident and, as a rule, the better the cushioning properties of a tire the less will be the impact on the road surface. In some of our experiments we have equipped the same trucks with different kinds of tires, first with solids, then with cushion tires, and finally with pneumatic tires. In one case a 2-ton truck was used and it was noted that when equipped with solid tires the impact, say at 16 miles per hour, is from four or five times as much as the mere weight on the rear wheel of the vehicle. When equipped with pneumatic tires the impact is only about 75 per cent greater than the static weight, and cushion tires give an intermediate effect.

These results when carefully studied give very strong indications that so far as conservation of the road is concerned, it would be economical to require that all vehicles be equipped with pneumatic tires, but we must be practical and take into consideration the limitations of the pneumatic tire for carrying heavy wheel loads. Like investigations have involved cushion wheels of several different types, as well as a number of types of cushion tires. So far as the cushioned wheel is concerned much depends upon the design. The idea of all cushion wheels is to give extra movement of the hub with respect to the pavement surface and in so far as they accomplish this object they reduce the shock to the vehicle. Our tests, however, indicate that several types of cushion wheels do not decrease the impact delivered to the road surface, which is probably due to the heavy rim construction necessary. This by no means indicates, however, that they are not efficient in accomplishing the purpose for which they were designed, namely, that of reducing shock to the vehicle. It does indicate, though, that vehicles thus equipped may be just as destructive to the road surface as those not so equipped. On the other hand, other designs of cushion wheels do lessen the shock to the road surface. Details of these studies have likewise been published.

Other tests have included special cushion tires and certain of these tires seem to be very effective in alleviating impact pressure on the road surface, although none of them are as effective as pneumatic tires. In general, the results show that under the most extreme conditions there is the possibility of obtaining impact seven times as high as the static weight on one rear wheel. The average value is perhaps about four times that of the static weight, when the truck is equipped with solid tires. The average impact value when equipped with pneumatic tires is only about 1¼ times as much as the static weight. Road destruction undoubtedly is related in some degree to the impact received, and ultimately it is possible that legislation will indirectly take cognizance of this fact.

Effect of Impact on Road Surfaces

We still have under way a large series of investigations of impact on road surfaces of different types and we have completed a large series of tests on rigid pavements, involving plain concrete of different construction and brick pavements having different types of fillers and different types of foundations. Details of the results thus far obtained have been published (Public Roads, Oct. 1921). We have built slabs of different design directly on the subgrade. The slabs are seven feet square. Previous studies and road tests made by us indicated that this size was sufficient to distribute the load to the subgrade. Then, too, we had in mind that if a pavement of the rigid type were to break into pieces smaller than this, failure would be considered complete, and we have worked, therefore, on the assumption that if slabs of this size are capable of resisting the impact to which they would be subjected in a pavement, the pavement would still be very serviceable.

The testing machine was designed to resemble the conditions on the rear wheel of a 5-ton truck. It consists of an unsprung weight of 1,800 pounds shod with a solid rubber tire and carrying a heavy truck spring supporting a weight of 6,000 pounds. By means of the proper mechanism the entire weight is allowed to fall repeatedly on the center of the test specimen, 500 blows at 1/8 of an inch, and 500 blows at increasing heights of 3/8 of an inch, deflections of the slab being measured, and other careful observations taken as to the condition of the slab. Curves were made in connection with the tests on concrete slabs 6, 8 and 10 inches in thickness, the point of sudden curvature indicating that a crack had formed, ultimate failure taking place soon after this. It only required 640 blows to cause failure of the 4-inch slab, 1,239 blows for the 6-inch slab, 2,552 blows for the 8-inch slab, and 6,000 blows were delivered to the 10-inch slab without producing failure, and it was considered that the 10-inch slab would have withstood a very large number of blows without breaking.

Similar curves were made for various types of brick construction involving sand-cushion, semi-monolithic and monolithic brick on 4-inch and 6-inch concrete bases, and involving also bituminous filled brick on 4-inch and 6-inch concrete bases. From them it is evident that so far as resistance to impact is concerned the slab strength has great influence, and thus pavements which have greatest slab strength, very broadly speaking, will have the highest resistance to impact. Such a statement can, of course, not be taken without qualification, for these tests were made on a medium soft subgrade, and of course, the supporting valve of the subgrade influences the resistance which the slab will be called upon to offer. For instance, where the subgrade is soft the slab must be subjected to considerable bending, and must be capable of resisting this bending. Whereas, if the subgrade is exceedingly hard, the load is transmitted to the subgrade without producing much bending of the road slab; and naturally on subgrades of high supporting value, slabs having lower resistance to bending can, therefore, be used then on subgrades of low supporting value.

Thus far we have tested 56 slabs, some laid on a wet subgrade and some on a dry subgrade, there being, however, not very much difference in the supporting values of the subgrades. As a result of the preceding series in which we have determined the impact value of different motor trucks, we have been able to arrive at some conclusion through analysis of the results, which throws considerable light on the proper thickness of concrete slabs for subgrades having bearing values approximately like those in these tests.

We do not propose the following analysis as a rational method of design but simply offer it as an analysis which goes far to aid our judgment in election of the proper thickness of concrete surfaces under the stated conditions of subgrade to meet stated conditions of traffic. We consider that the maximum impact of motor vehicles is invariably delivered by the rear wheels. An analysis shows that the total weight on the rear wheels of motor trucks of all sizes is practically directly dependent upon the load carried on the truck. From a mass of some 4,000 or 5,000 impact tests of motor trucks of different weights and sizes, running at different speeds, we have been able to plot curves indicating what impacts are generally to be expected from motor trucks with known weights on the rear wheels.

It must be emphasized again that this analysis does not offer the rational method of design of general application but merely serves to aid our judgment of what the proper thickness of the road might have to be in order to successfully carry traffic of the weight indicated when the subgrade conditions are such as obtained at Arlington Farm. We have obtained a definite measure of these subgrade conditions through an impact test to determine the bearing value of the soil. The apparatus consists of a weight of ten pounds which is allowed to fall from a height of three feet upon a circular plunger also weighing ten pounds and covering an area of about fifteen square inches. The penetration of this plunger under 50 blows varied from two to four inches depending upon the variations of the subgrade.

Temperature Stresses in Concrete Pavements

It might be thought, without stopping to consider the matter to any great extent, that when concrete is poured upon the subgrade, is finished and hardens to form a concrete pavement, thereafter there should be offered practically uniform support by the underlying subgrade provided there is no heaving of the subgrade. But, of course, this is far from being the case.

Let us assume for the time being that the subgrade remains in a uniform condition and does not change its degree of support or its elevation. Even under those conditions the slab does not bear uniformly because it is being continuously warped out of shape by changes in temperature. As the air temperature rises, naturally the top of the slab is heated up more rapidly than the bottom; there is an expansion of the entire top of the slab without corresponding expansion of the bottom of the slab and the result is that there is actual curling down of the edges and corners, making them bear harder against the subgrade than at the center and in fact, the center may be raised entirely free from the subgrade. On the other hand, at night as the air temperature falls, the top of the slab will be affected first and will be contracted, with the result that there will be curling up of the edges and corners to such an extent that they will be entirely free from the subgrade, the slab then being supported at the center.

An experimental slab was laid at Arlington for the purpose of determining the extent to which this curling action can take place. It is equipped with wells through which samples of subgrade may be obtained and with metal plugs set in the concrete upon which precise levels are taken. Autographic temperature recording devices, as well as autographic devices for measuring the movement of the slab, are installed.

Let us see what significance this warping action might have in connection with concrete pavement design. Let us assume, and this might very readily be the case, that there is a difference in temperature between the top and bottom of the slab equal to 36 deg. F.; let the pavement be 18 feet in width and 8 inches in thickness, and let the temperature at the top of the slab be lower than that at the bottom, the sides and corners thus being elevated from the subgrade. With a difference in temperature of 36 deg., there is the possibility of a warping up of the edge equal to 0.144 inches but owing to the weight of the slab those ends will be bent down 0.094 inches with a resulting tensile stress of 380 pounds per square inch tension in the top of the slab at the center. The edges of the slab would still be raised 0.05 of an inch off the subgrade, and if two vehicles passed one another there would be a possibility of bending the slab down into contact with the subgrade. If loads were applied at the extreme edges of the pavement, a running load of 183 pounds per foot of length would be sufficient to bring the ends into contact, and an additional stress of 150 pounds per square inch would be created in the center of the pavement, or a total stress of 534 pounds per square inch.

Nine Foot Slab Will Not Crack

When it is considered that 600 pounds per square inch is the modulus of rupture of concrete, it will be seen that under extreme conditions of warping, stresses are produced that might sometimes account for longitudinal cracking, omitting entirely from consideration the character of the subgrade. If the slab, on the other hand, is only 9 feet in width, the warping produced under the same conditions would be only 0.036 inches, the weight of the slab then producing a stress of 95 pounds per square inch, and the total stress at the center when the slab is bent down entirely into contact with the subgrade then being 465 pounds per square inch, requiring however a running load of 878 pounds placed at the extreme edges of a 9-foot pavement to produce this result. So it would seem that there is practically no possibility of a 9-foot slab cracking longitudinally owing to warping effects, whereas there is a strong possibility of a longitudinal crack forming in an 18-foot slab.

Effect of Moisture on Warping of Slabs

We must not forget the possibility of slabs being warped owing to moisture. It is a well known fact that concrete expands and shrinks upon being wetted and dried. Experiments made at the Bureau of Public Roads several years ago showed that from a wet condition to a condition of extreme dryness, obtained after three months hardening in a dry atmosphere, concrete will shrink from .05 to .06 inches per inch of length, approximately the same amount of shrinkage that would be expected from a fall in temperature of 100 deg. F. Concrete laid on a subgrade, however, will not be subjected to this extreme range because, although the surface is subjected to rapid drying, the concrete is in contact with a moist subgrade. There is certainly a possibility, however, of a difference in expansion at the top and bottom of the slab, since the bottom is apt to be subjected to more uniform moisture conditions owing to its contact with the subgrade. The top, on the other hand, is subjected to the extreme ranges of wetness and dryness.

Let it be assumed that the moisture coeffiicient of expansion is 0.00025, a figure much less than the extreme expansion possible. If an 18-foot pavement, 8 inches thick, such a slab will be deflected 0.182 inches, the sides being raised this amount. The dead load stress due to the weight of the slab alone will bend the ends down 0.094 inches and will produce a stress of 380 pounds per square inch, and if the sides of the slab were bent down by traffic there would be an additional stress of 271 pounds per square inch, or a total of 651 pounds per square inch. Again, it is seen that there is the possibility by stress tending to produce longitudinal cracking owing to moisture effects alone.

Similarly, there is possibility of high stress owing to the warping up of the corners of the slab due both to moisture and to temperature. Let me emphasize, however, that these are theoretical considerations which may or may not obtain in the pavement. There are several phenomena which tend to alleviate the severe stress conditions indicated by the theoretical calculations. Thus, the subgrade support is much more widely distributed than assumed in these calculations. Again, the phenomenon of "flow" of concrete, which has been investigated in the Bureau of Public Roads and elsewhere, would permit the gradual yielding of the concrete back into contact with the subgrade without the production of as high a stress as indicated. Nevertheless, the possibility of high stresses exists due to warping and should be very carefully considered in the design of pavements.

Investigations of the Subgrade

Let us next look into the influence of the subgrade on the design of pavements and consider some of the investigations that are being carried on to determine how to take this influence into account. For our purpose we consider that soils are made up of particles of various sizes extending all the way from gravel down through sand, silt and clay, even to particles known as ultra clay, which are so very fine that when stirred up in water they will never settle to the bottom. Imagine, if you will, a soil made up of these extremely finely divided particles. Such a soil when saturated with water would have no inherent stability and would support practicallp no load at all, but as more and more coarse particles are mixed with such a material it can readily be imagined that such particles would furnish a skeleton structure through their arching over and intimate contact and such a soil would then have some stability even when wet.

In the laboratory we have been analyzing by means of physical tests a number of samples of soil which have been taken from road failures as well as from road successes. Briefly, these tests are as follows:

1. Mechanical Grading. The soil is analyzed to determine the range of sizes of its various particles. This is done by first boiling a 25-gram sample of the soil in water for a few minutes, allowing the liquid to settle for eight minutes, then pouring off the supernatant liquid. Washing and settling are repeated until the supernatant liquid is clear. The sample remaining after washing contains silt and particles larger than this. The dried sample is then passed through the No. 200, 100, 50 and 20-mesh sieves, that passing the 200 being recorded as silt, and that above as sand. The clay and ultra clay are contained in the water used for washing the sample. This is thoroughly agitated and the sample is placed in a centrifuge and whirled for half an hour at a speed of 1,500 revolutions per minute, thus precipitating the clay but not the ultra clay, which remains suspended in the liquid. The ultra clay is recovered by pouring off this liquid and evaporating it to dryness. Thus there has been determined the percentages of clay, ultra clay, silt, and the various percentages of sand particles.

2. Tests are also made for the so-called water holding capacity of soils by immersing a sample of the soil and obtaining the weight of water taken up by the sample. This varies tremendously, depending very largely on the grading analysis of the soil.

3. Moisture Equivalent. The moisture equivalent of a soil as determined in our laboratory is the percentage of moisture retained by the soil when subjected to a centrifugal force equal to about 750 times the force of gravity for a period of one hour. In this test the sample is allowed to take up moisture by capillarity and is placed in a perforated container so that when whirled in the centrifuge the excess water

will be thrown away from the sample. After centrifuging for one hour the sample is again weighed and the weight of water remaining when converted into percentage is the moisture equivalent. This is a very important test as the moisture equivalent seems to be a very good indication of the bearing value of a soil and is likewise a good indication of the difficulty of draining it.

Capillarity

4. Vertical Capillarity. Water will climb vertically through soils in much the same way that oil is lifted through a lamp-wick, by the force of capillarity, and some soils have the power of drawing water from quite a considerable depth. The test for rate of capillarity is made by noting the time required for water to climb through a sample of soil held in a glass tube. the height of the sample being 20 centimeters. The capillary action of soils is exceedingly important in connection with their drainage. Some of the finely divided soils are capable of high lifts, while some of the granular or sandy soils have very little power of vertical capillarity.

5. Volumetric Change. This is a test to determine how much shrinkage takes place in the soil from its saturated to its dry condition. It will readily be understood that this is a most important property of soils for if the subgrade dries out unequally and therefore shrinks unequally, as it does in a great many cases, unequal support is offered to the road. There are instances in which, owing to the subgrade shrinking at the sides of the road, there has been actual separation of an inch or more between the road surface and the underlying subgrade; and soils such as these cannot be depended upon to offer adequate support even when they are dry.

6. Comparative Bearing Value. The most important property of soils is their bearing value or their ability to support loads without much yielding. When we consider that the wheel loads on some of our big motor trucks may be 10,000 pounds and more, we can readily see why it is important that soils must be capable of supporting high loads without yielding. In the laboratory this property is determined by preparing samples of soil with various percentages of water, subjecting them to definite compaction by means of pressure and then testing them in a special machine in which a plunger having one square inch of area is loaded by a gradually increasing load, and simultaneous load and penetration readings are taken during the test. For comparative purposes the bearing value of the soil is taken as that load in pounds per square inch required to produce a penetration of one-tenth of an inch.

7. Adsorption Test. It is believed that the extremely finely divided particles which are known as ultra clay have considerable to do with giving the soils their plastic properties, and it appears that ultra clay from various types of soils varies widely in its characteristics. It is no doubt true that even these extremely finely divided particles, so fine that they will remain indefinitely suspended in water, have a wide range of size in just the same way that sand is composed of widely varying sizes, and this may account for the different properties of colloidal or ultra clay. The so-called adsorption test is in some degree a measure of these different properties of ultra clay. Finely divided particles have the ability to decolorize dye solutions, some samples very much more than others, and the adsorption test is made by determining the amount of dye which can be decolorized by allowing it to filter through a given sample. That sample which has the highest adsorption is likely to render the soil most plastic.

These laboratory tests have been made on a number of samples but we are not yet prepared to say definitely what range of characteristics of soils corresponds with their behavior in the field.

Influence of Soil Bearing Value on Non-rigid Surface

In order to properly understand how the bearing value of the subgrade might influence the design of a non-rigid surface, such as gravel and bituminous macadam, it will be necessary to know something of the manner in which pressures are distributed through such surfaces to the subgrade. Experiments have been made to show how pressures would be distributed directly on the subgrade under the wheels of a heavy truck. These particular tests were made by measuring the pressures under layers of sand from 6 inches up to 5 feet in thickness, the two curves shown being those for the 24-inch and 12-inch layers. The point to be observed in these curves is the fact that when the layer of sand is only 12 inches thick as compared with 24 inches thick, there is a higher intensity of pressure under the load. We found that when the layer of sand was 5 feet thick the pressures were very widely distributed and were of very low intensity. The lesson to be learned from this is, of course, that the thinner the road surface the higher will be the intensity of pressure on the subgrade, and if the subgrade is soft it becomes very evident why we must have a thick road surface in order to properly distribute the pressure and at the same time reduce the intensity of pressure so that it will be less than the bearing value of the subgrade material. Subgrade material of high supporting value, on the other hand, will permit of the use of a thinner wearing surface because a higher intensity of pressure will be permitted on the subgrade.

Drainage Investigations

It has been mentioned that the water content of the soil greatly influences the bearing value and it is highly important, therefore, that every possible precaution be taken to reduce the percentage of water in the subgrade to a minimum. A series of tests has been under way at Arlington for several years in which ten different drainage experiments have been made.

Without going into detail it is very evident that freezing of the top layers of soil has an effect in increasing the moisture content of these layers and in decreasing the moisture content in the layers immediately below the frozen portion. Evidently freezing has the effect of withdrawing moisture from the underlying layers and concentrating it in the frozen layers. This possibly accounts for the extremely high moisture content under road surfaces in the spring of the year. This series of tests is not completed yet and will be carried on further in the field and it is hoped that finally there will be evolved efficient methods of drainage of different types of soils under various conditions of topography.

It is needless for me to point out that there are still innumerable problems to be solved, many problems other than those dealing merely with the structural design for we have just begun to touch the field of road economics.

One very important research which we are now undertaking deals with the study of the elimination of the causes of shoving and creeping of bituminous pavements. This is being undertaken in co-operation with the Asphalt Association by procuring samples of asphalt pavements which have shoved under traffic. These samples are now being sawed into the proper shape and will soon be subjected to laboratory investigations. In addition to this, a field test is being constructed in which a motor truck will be run around a circular track composed of a number of different types of asphalt sections and the behavior of these sections will be noted under traffic. New series of slabs have likewise been laid at Arlington Farm, comprising a number of reinforced concrete sections and a number of sections with bituminous tops. These will be subjected to impact in much the same manner as I have described.

Another investigation which promises important results is that of the causes and elimination of corrugating or "washboarding" of gravel road surfaces. Under the action of traffic, corrugations form in many gravel roads, the distance between the crests of the waves being 25 to 36 inches and with a normal maximum height of 1½ inches. It seems to be the case that such corrugations very readily develop in gravel surfaces under 30 feet in width under a traffic more than 400 vehicles per day, and much depends upon the character of the gravel and its binding material.

It will be noted that the experiments which have been described aim to establish fundamental principles in connection with the design of roads. As is well known, in the past too little thought has been given to the various conditions which should be taken into consideration in deciding upon a proper road design. Too much reliance has been placed upon the behavior of an apparently similar road, which, however, may be subjected to entirely dissimilar conditions. Let us establish the art of road building as an exact science and to this end let us obtain and use the underlying, fundamental facts.

Government Dry-Dock at Esquimalt

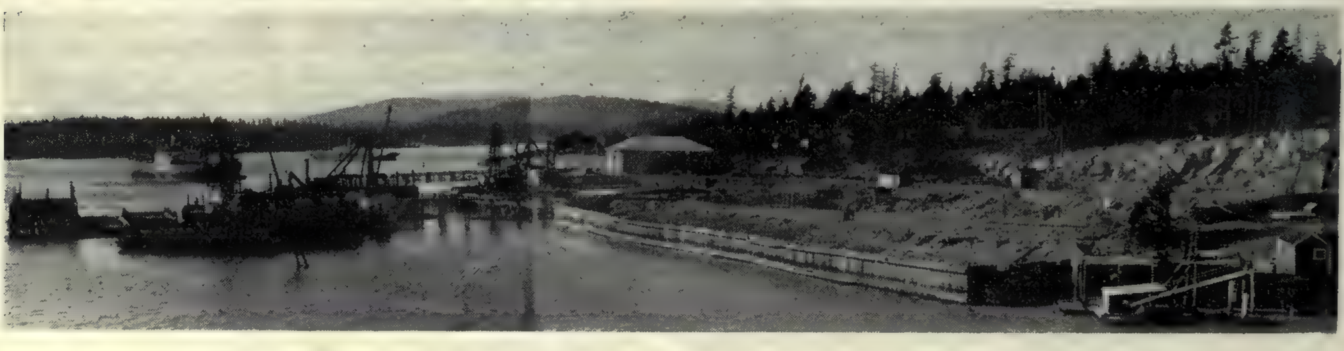
Work Stopped on March 31 by Dominion Government Order — Public Bodies Urge Continuance of Operations—Progress Was Such as to Ensure Early Completion of First Unit

By J. B. HOLDCROFT
Contract Record Correspondent

Considerable stir has been occasioned in Victoria and the surrounding districts by the order issued on March 31st by the Dominion authorities stopping work on the construction of the drydock at Esquimalt, on which a considerable amount of work has already been done, and over $1,125,000.00 have already been spent. The announcement came as a surprise to all parties concerned, although rumors had been current for some time that at least a temporary shutdown might be ordered. When the order actually was received, it was apparently couched in such terms as to give color to the fear that the shut-down is likely to amount to abandonment, and as the work has been giving employment to about 350 men, who are all laid off from the 1st of April, public bodies and organizations interested in employment were naturally aroused over the matter, and Ottawa has been flooded with telegraphic protests in consequence. This has resulted in the holding out of a grain of comfort in the suggestion that a sum of money for continuance of the work might be included in the supplementary estimate which will be brought down at the end of the session.

To date some 160,000 cubic yards have been excavated from the dry-dock site, and 100,000 cubic yards of material dredged from the approaches, and it had been expected to have the first section of the dock well-nigh completed before the year was out. The contract was let on December 25th, 1920, and actual work was commenced almost exactly twelve months ago.

In the messages which have been sent to Ottawa urging continuance of the work, stress has been laid on the unemployment situation, which is still very serious in Western Canada, and also upon the necessity of the dock to the shipping and ship repairing interests on the Coast. It is pointed out that the ports of the United States to the south, Seattle, Tacoma, Portland and San Francisco, are all alive to the opportunities for this work in connection with the growing trade on the Pacific, and that the western Canadian ports should be in a position to compete on an equal footing for this work.



General view of Esquimalt dry-dock taken on April 8 after cessation of work as ordered by the Dominion Government

Slag Concrete houses at Donora, Pa.

Building Tile Made From Slag Has Many Advantages

The National Slag Products Limited was incorporated in July 1921, under Dominion charter, for the purpose of manufacturing hollow building tiles from granulated blast furnace slag, a waste material secured by long term contract from the Steel Company of Canada, Hamilton, Ont. The company is capitalized at $300,000.00 and has a very representative board of directors as follows: Hon. Senator G. D. Robertson, president, Ottawa, Ont.; David Dick, vice-president, National Sand & Material Co., Welland, Ont.; Edwin J. Robertson, manager, Wentworth Arms Hotel, Hamilton; J. P. Anglin, director, president Anglin Norcross Const. Co., Montreal, Que.; W. R. Fleming, director, manager Canadian Debentures Corp., Toronto; H. J. Daly, director, president Home Bank of Canada, Toronto; Gordon J. Hutton, director Hutton & Souther, Architects, Hamilton, Ont.

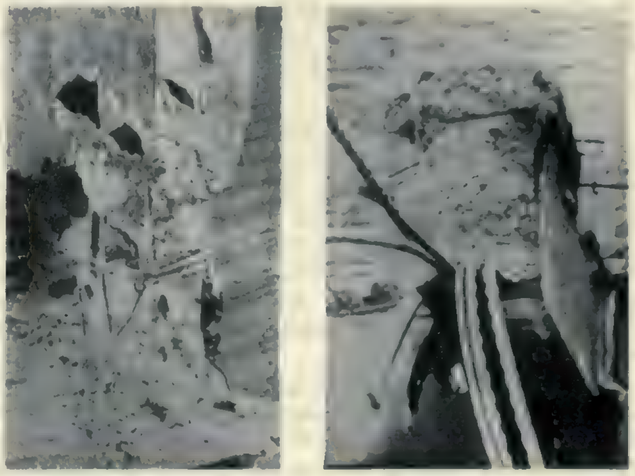
In addition to manufacturing all standard sizes of building tile the company will manufacture reinforced roofing, prepared plaster and field drain tile.

Granulated slag is the refuse from the fluxes used in the manufacture of steel, and is granulated into a substance similar to sand by turning a stream of cold water into the molten slag as it runs from the blast furnace. As each particle is full of small voids this material is very light.

Edwin J. Robinson, manager of the company, has perfected a process whereby this material can be manufactured into hollow building tiles, and other building materials. A specially designed machine has been constructed for the manufacture of building tiles; this machine is exceptionally efficient and has a capacity of seven thousand sq. ft. per day.

Unlike the clay tile which takes from 10 to 14 days to manufacture, the Slag-Crete tile can be turned out in twenty four hours and requires no heating, other than steam for steam curing purposes, which speeds up the curing process.

The light weight of the tile will save on the cost of laying them in the wall, on the cost of transportation, and on the dead load to be carried on the frame work of the building, which will save, in turn, in the cost of the frame work for the building, as lighter frame work can be used. It is claimed that Slag-Crete tile will take a nail as readily as wood, and has unusually sound proofing and heat insulating qualities. Stucco or plaster will adhere to these tiles very permanently, as the aggregate in all materials is practically the same. This guarantees against cracking or crazing of the stucco or plaster when applied, as the construction of all three materials will be practically the same.



Fifteen year old slag concrete reinforcement, Ulmer Building, Cleveland, Ohio. Erected 1905, torn down 1920. Reinforcement in perfect condition —good as when placed

James Owens, late superintendent of Section No. 1 of the Welland Ship Canal will be works manager.

The company's plant on Gage Ave., Hamilton is nearing completion, and production is anticipated about May 15/22.

"Stories of Little Wonders" is the title of an illustrated catalogue descriptive of the Little Wonder suspended scaffolds, manufactured and leased by Fischer and Hayes Rope & Steel Co., Chicago. The Little Wonder scaffold machine is a simple and compact device for raising and lowering scaffolds from the platform. Instructions for operating the equipment are contained in the catalogue, in which are also shown photographs of contracts on which the Little Wonder machines have been used.

Price-Rothbun stationary oil engines are very completely described and illustrated in a bulletin issued by the Canadian Ingersoll-Rand Co., Sherbrooke, P. Q. The specifications and operating characteristics of this type of engine are fully detailed. A copy is available from the company on request.

"Partners"

It is only a little while ago that industrial relationship was expressed in the phase "master and slave." Then came "master and man." Today we talk of "employer and employee.' Soon or late we must learn to say "partners," and with that new word will come the first dawn of industrial peace.—A. S. Bent, president of the Associated General Contractors of America.

Mainly Constructional

East and West—From Coast to Coast

A committee consisting of several members of the city council of Brandon, Man., will investigate and report to the council on the city manager scheme of municipal government.

Reports from Nova Scotia state that highway work is already under way in several sections of the province. This is the earliest date that road construction has been commenced for several years.

The Ontario Government has received a requisition from the University of Toronto for four new buildings, these being new Forestry building, Botany and Administration buildings and Women's building, at a total cost of $1,500,000.

The township of York, Ont., during the first week of the present month issued permits totalling $500,000 in value, which represented 150 houses. This month promises to break all previous records in the number and value of permits issued.

Bricklayers at Windsor, Ont., who had been on strike since the first of the month, decided recently to accept the employers' offer of $1.00 an hour for the present season. The men were holding out for last year's rate of $1.12½ an hour.

The Electric Steel & Metals, Ltd., plant at Welland, Ont., has been sold to an American organization. The building has been standing idle since the munitions industry dwindled. It is proposed to turn the plant into a steel rolling mill, turning out bars, sheets, etc.

Reports from the Owen Sound, Ont., district state that the roadways which were re-surfaced with tar macadam have come through the winter in excellent shape. This has been Owen Sound's first experience with this type of surfacing and road officials are well pleased with it.

Mr. L. W. Sharpe, of the legal firm of Sharpe & Niblett, of Hamilton, addressed the local chapter of the Ontario Association of Architects at their recent semi-monthly meeting, pointing out the many legal tangles that architects may avoid by the possession of a little legal knowledge.

The Montreal-Quebec highway is now open for summer traffic according to a recent announcement by the chief engineer of the department of roads. There remains a section of a mile near Lorette, which is not yet opened, but another section near there is in good condition, so that Quebec can be easily reached.

The cost plus system which has been in force on Section 3 of the Welland Ship Canal since the war is to be abandoned for the contract system now used on the other sections of the canal. Inventory is now being taken on Section 3 and when it is concluded all work on the section will cease and tenders will be called for.

The annual exhibition of the work of the University of Toronto undergraduates in architecture was held at Hart House recently and the several architectural authorities present were greatly pleased with the class of work displayed, which was stated to be comparable with the work of the European Art Schools. Other exhibits included water colors, plaster statues and relief work in plaster.

The Real Estate Board at Hamilton is planning a Better Homes & Industrial Exposition, to be held at the armouries during the week of June 5. The local Chamber of Commerce is co-operating with the above organization in the preparation of an interesting program of entertainment and educative features and judging from the enthusiastic manner in which the scheme has been taken up by these directing bodies, it should meet with success.

It is announced that the Canadian Pacific Railway Company will spend over $500,000 on improvements and additions to their coal handling facilities at their big coal docks on Island No. 1, at the mouth of the McKellar River, near Fort William, Ont. The McMayler Interstate Construction Company, of Chicago, have the contract for the work which will include the installation of a huge storing or distribution crane and the general enlargement of the present plant.

The Metropolitan Commission at Montreal has named the following commission to look after requests from the various municipalities of Montreal Island for housing grants from the provincial government allotment for this district: Ald. J. A. Brodeur, Ald. Sansregret, Mayor Leclair, Mayor Beaubien, Ald. Elie and Mayor Ballantyne. Although the commission, as yet, have no housing funds from the provincial government, it is the general opinion that this money will be available again this year.

Personal

Mr. C. V. Hodges, architect, 235 Quebec Ave., Toronto, is moving his office to the Merchants Bank Bldg., King St., Kitchener, Ont. and will be glad to receive samples and catalogues there.

Mr. Thos. Adams, town planning expert, has been employed by the city of Kitchener, Ont., to prepare a plan of the city. At a recent meeting the city council authorized the preparation of survey maps which will form the basis of the new plan.

Obituary

Mr. Charles Simpson Boone, president of the C. S. Boone Dredging & Construction Co. Ltd., of Toronto, died recently at his home in that city, in his 68th year. Mr. Boone was born at Oakville, Ont., and was educated at Rockwood Academy. Although he had taken no active part in the business of his firm during the past five years, the company has been busy on the Chippawa power canal construction. Among other large undertakings with which Mr. Boone has been connected were dredging and harbor improvements contracts for the Dominion Government at Collingwood, Little Current, Port Arthur and the Canadian Soo.

Trade Incorporation

Messrs. Patten Brothers Limited, with head office at 367 Ouellette Ave., Windsor, Ont., capital $40,000 to carry on the business of contractors, builders and manufacturers of builders' supplies. The incorporators are Messrs. George B. Patten, formally associated with Lundy's Limited, president of the company, and Frank. B. B. Patten, secretary treasurer.

ESTABLISHED 1886

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Is There Anything to Say for the Cost-Plus Contract?

According to the National Federation of Construction Industries five to fifteen percent. of the total construction business in the country can hardly be done on any other basis than some form of cost plus. The next portion relatively greater by a considerable margin, is that which is usually done on a unit price basis, but which might be open for consideration on a cost plus basis. The remaining and greatest portion is now almost invariably done on a lump sum competitive basis. These proportions are not likely to be changed in any large way, but there is a great deal on a lump sum basis which ought to be handled on a cost plus fixed fee or cost plus percentage basis.

In commenting on this the Federation of Construction Industries states that there is no question but that the cost plus basis requires complete confidence on the part of the owner in the integrity as well as the competence of the contractor. Both were lacking in some of the contractors doing cost plus work during the war, and to this fact is attributable the bulk of the unsatisfactory results secured. Aside from this fact speed was a primary consideration and costs were deliberately put into second, third, or fourth place, for perfectly good reasons, but in the "cold morning after" analysis, costs were scrutinized first, and the erroneous conclusion drawn that the cost plus basis was rotten, led to graft and was open to so many criticisms that it was entitled to no place in the consideration of conservative business men.

The truth is that on any construction job on which the estimating is difficult, and on the average industrial plant, power plant, and buildings of any character costing more than $100,000, some form of fee compensation will produce more satisfactory results, 99 cases out of 100, than will the lump sum or any other form of contract, provided it is placed in the right hands. This last point is stressed by the Federation and made the basis of the success of the cost plus scheme.

Ask almost any man who has built a house during the last two or three years on a lump sum competitive basis, how much more it cost him than the contract price. It is hard to find a man who did not pay 25 to 100, and in some cases more than 200 per cent. excess to get the house he thought he was buying for the face of the contract. In other words, a lump sum bid is in no sense a guarantee of the final cost.

One contractor writes: "We are just finishing a job for one of the well-known railroads on which we have saved over $300,000 on an estimate of a little less than two million, made about a year ago. The estimate was carefully made in great detail in the light of market conditions of that date. The combination of the falling market, increased efficiency of labor and favorable winter weather, have combined to make this saving possible, but it is our judgment that a lump sum contract placed after the loss of one or two months' time for the completion of drawings, would not have produced lump sum bids more than $25,000 or $50,000 lower than our estimate. A difference of at least $250,000 would have gone into the pocket of the contractor instead of reverting to the client as a saving. In addition to this fact, we were able to start construction work almost as soon as drawings were authorized, and by eliminating the period ordinarily consumed in the making of plans, taking of bids, and letting of the general contract, we placed the client in his new building at least two months, and probably three, earlier than would have otherwise been possible, which meant the elimination of rental in his former quarters which would have totaled two or three times any alleged difference between a lump sum competitive bid and our original estimate."

The foregoing occurred in a falling market, but just as good a case can be shown in a rising market, when a contractor on a lump sum basis has to protect himself against the expected rise in costs of everything entering into the job that he will have to buy during a period of perhaps a year or more. The owner pays on a basis of the contractor's expectation, and the contractor may be depended upon to estimate high enough to protect himself on a lump sum basis. The sooner the construction industry becomes so organized that a contractor can build a house for the contract or estimated price, or lower, the better it will be for a sound resumption of construction activities and the re-establishment of public confidence.

New Wharf at Wallaceburg, Ont.

Mr. Norris E. Gibb, marine contractor, Sarnia, Ont., has just completed a wharf for the Dominion Sugar Company, at Wallaceburg, Ont., for the unloading of raw sugar which will come direct from New York by way of Erie Canal barges. Mr. Gibb is just starting on another contract for rebuilding a dock at Sarnia, Ont., for the Port Huron & Sarnia Ferry Company.

Can Building Construction be Made Less Seasonal?

David Lupton's Sons Company, a U. S. concern, recently sent a questionnaire to architects, engineers and large manufacturers in the eastern half of the United States, to disclose whether the main obstacle to winter building is its higher cost, and, if so whether it would be feasible to stimulate it by winter reductions in prices of materials and in wages and profits.

Replies indicate that on small work, such as residences, the cost of rearing the wall construction would be impracticable. Where the climate is not too severe, work can be carried on between cold waves. This puts the immediate loss on the men, who must make up the idle time by higher wage scales on days they work.

On large construction projects work can be carried on by using tarpaulins and heating appliances, at from 3 to 10 per cent extra cost. At present, this differential is paid usually by the owner, due to his need for early completion. Sometimes part is absorbed by the contractor through competition; sometimes, part by labor on account of competition for work; sometimes part by the material men, through desire to maintain production in the slack season. Opinions of large contractors indicate that this form of winter construction could be stimulated by a general practice among all parties interested to reduce winter prices enough to make winter construction attractive.

Regarding industrial buildings, a difficulty arises because expansions are authorized by a corporation usually at its January annual meeting. If no preliminary plans have been made, it is likely to be May or June before the contractor gets started. This situation could be helped, if intending builders would prepare plans the previous fall, so that only revision and refiguring would be required after the January meeting, thereby enabling an immediate start by the contractor.

David Lupton's Sons Company intend to carry their investigation further, as the advantages of uniform manufacturing conditions for material producers, and of uniform employment in the building trades, are so great as to deserve an earnest effort to bring them about.

92½ Cents is Toronto Bricklayers' Wage

A reduction of seven and a half cents an hour in the wages of union bricklayers and stonemasons of Toronto is the result of the award of the Board of Arbitration, appointed to deal with the matter which on April 20 made a finding setting the rate of wages for the ensuing year at 92½ cents an hour instead of the $1.00 per hour scale, which was paid last year and which has been continued so far this season. The award set May 1 as the date on which the new rate will go into effect.

The finding was made under protest from the union's representative and was not signed by him, the signatures of the chairman, Rev. Byron Stauffer, and the employers' representative, Edward Teagle, only being attached. The award stated:

"Having considered the gradual resumption of normal conditions in the business and industrial world generally, including the fall in the cost of living, the prices of materials and the gradual reduction of wages throughout the continent, it is the opinion of this board that 92½ cents per hour would be a fair wage for bricklayers and stonemasons in the city of Toronto during 1922, and the same is hereby awarded."

Under the terms of the international agreement existing between the two bodies, the matter went practically automatically to arbitration when negotiation for a settlement failed. Similarly, the agreement requires that both parties shall accept the award of the arbitrators.

Officials of the employers' organization viewed the finding of the board with satisfaction, and expressed the belief that the reduction would do much to bring on some big jobs which have been waiting for just such further evidence of reduced costs.

New Idea in Portable Concrete Garages of Pre-Cast Units

A concrete garage that can be delivered on an ordinary truck and that can be erected and made ready for occupancy in a day's time is a recent achievement.

The entire garage, with the exception of the concrete floor, which is cast on the ground, is constructed of pre-cast units, including slabs, pilasters, sills, plates, collar beams, rafters and other necessary pieces. Lightweight aggregate is used in the manufacture of these units in order to keep the weight down so that two men can easily lift and handle the largest pieces.

In building the garage the concrete floor is placed first. After this has hardened a pilaster 8 feet high is erected at the corner and a section of concrete sill placed. Then one of the slabs, which are 33 inches wide, 8 feet long and 1 inch thick, is put into place. The pilasters and sills are slotted so that the edges of the slabs will fit snugly into them. Next, an intermediate pilaster, slotted on two sides, is erected; another section of sill is laid and the second slab placed. This operation is kept up until the building wall is completed. Pre-cast plates similar to the sills are then fitted on the top of the wall. To prevent spreading opposite sides of the wall are tied together with pre-cast collar beams. These beams are bolted at the ends to the pilasters by means of bolts embedded in the pilasters at the time of manufacture. The roof, which is of slab construction, is supported by pre-cast concrete rafters three feet apart. The lower ends of the rafters rest on the pilasters and are bolted to them with the same bolt that passes through the collar beams.

Doors consist of concrete slabs cast in special steel frames which are provided with hinges so that the various sections will fold together. Bolts for the attachment of hinges are embedded in the concrete corner piers at the time of their manufacture.

Window sashes are also made of concrete and are glazed with wire glass panes. Special short length wall slabs are used above and below the windows. These are slotted on the ends next to the window so as to get a good tight joint. The sides of the sash fit into the slots in the pilasters.

No mortar is used anywhere in the construction of the garage, and, if at any time it is decided to move the building, it can be taken apart readily and the units transported to the new site and the garage rebuilt.

The firm of Doran & Devlin, general contractors, Ottawa, Ont., has been taken over by the Doran Construction Co. Ltd., which has been recently incorporated with a capital of $100,000.00.

Methods of Tunnelling in Wet Ground

A Survey of the Most Approved Practice in Sewer Construction Under Various Underground Conditions—Types of Timbering —Compressed Air Installations

By W. G. CAMERON
Assistant Engineer, Sewer Section, Works Department, City of Toronto

In the ordinary course of events, when it is decided that a tunnel must be built in wet ground, compressed air is used to facilitate the execution of the work. The first problem is to decide the size of the pump or pumps (for two are generally used) and the pressure which will be required. The required capacity of the pumps can usually be determined by obtaining a knowledge of the conditions of the ground and considering the size of the future tunnel. On the other hand, we can never be sure of the pressure that will be required. Of course, we have to consider that it is necessary to slightly more than balance the pressure of the incoming water, but this amount of pressure cannot be accurately ascertained until the work is under way.

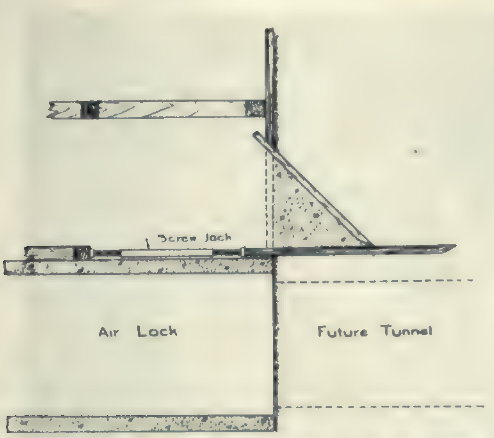


Fig. 1—Wedge used to seal the space over lock or future tunnel.

Perhaps the water lies in a seam of sand or gravel, overlying an impervious seam. Then determining the pressure is a simple problem, for, as a rule, it is a plain case of head. On the other hand, if the water lies under an impervious seam, it may come from anywhere and, perhaps, gain an entrance miles away and likely at a much higher elevation. In another case, the natural outlet for the water may be larger than the natural inlet, so that the water on running out creates a vacuum behind it which, from time to time, will counterbalance by suction the head pressure, and the result will be that the required air pressure will vary. Then again the water may be contained in small local pockets with only a local source of supply. This condition is similar to the first and the problem which presents itself is a simple case of head. Again, we have the case where the tunnel must cross an old water course, which may have been long since filled in and is covered with many feet of earth. But in the bed of the old channel will be sand, gravel and boulders, with water present in quantity. There are many variations of these cases which may be met with locally and will have to be dealt with as they are found. Roughly, it may be estimated before commencing work on any job that one-half pound of pressure will be required for every foot of depth and a tentative installation of two units of 750 lbs. capacity each may be made, with two 50 h.p. motors for driving them. This installation will be ample in most cases, but where extreme conditions are encountered, this plant may be augmented if found necessary. The above mentioned cases will be taken up and the most economical method of doing the work will be indicated.

Water in a Stratum Over an Impervious Seam

The first case mentioned is where the water lies in a stratum over an impervious seam. This water may be in great quantity or may be only a seepage. In both these cases, the required volume of com-

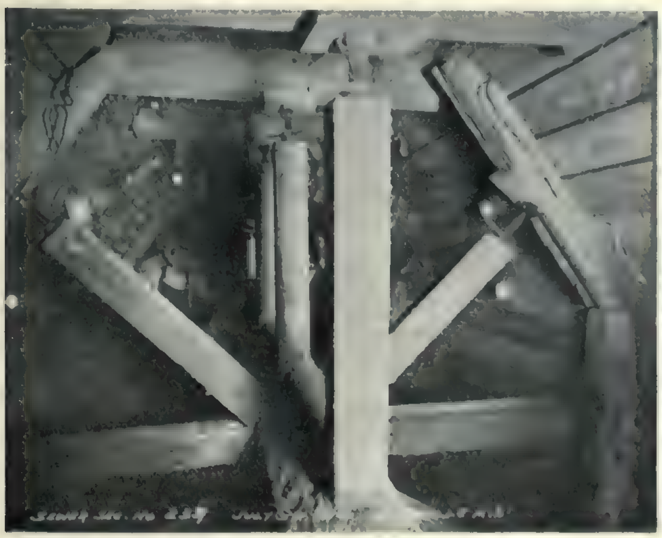


Fig. 2—Needle beam timbering supporting sheeting.

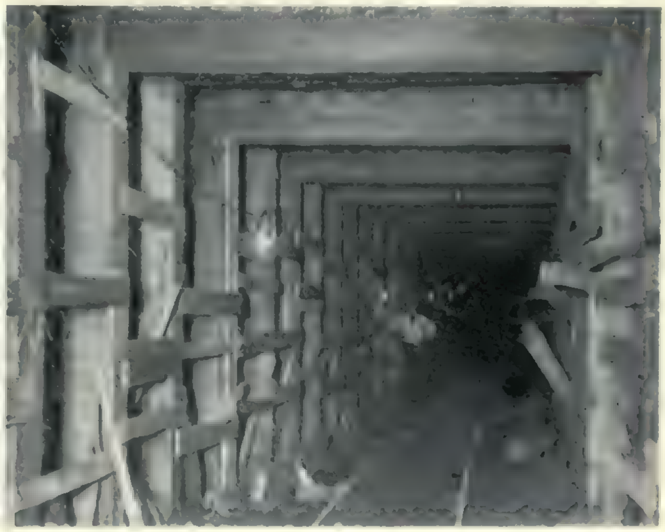


Fig. 3—Cap and leg timbering in a location where the soil is all fine dry sand.

pressed air will depend largely on the size of the required tunnel, the class and looseness of the material through which the tunnel must pass and the class, density and thickness of the overlying earth. It is likely, unless the cover is quite deep, that the excavation for the installation of the air lock on each side of the shaft must be made in open cut (approximately 30 ft.). Should the locks be built in tunnel it is impossible not to leave a space over them between the masonry and the solid ground where the air will escape from the heading. It is customary, therefore, to build a concrete wedge over each, as shown in Fig. 1, or to sink a small excavation, the width of the tunnel, over each lock and block this space with concrete. Even where the locks are built in open cut, these precautions are sometimes taken. After the locks are completed, the open cut is filled in, leaving a space in the centre for a shaft which is lined with masonry to a point above the possible water line.

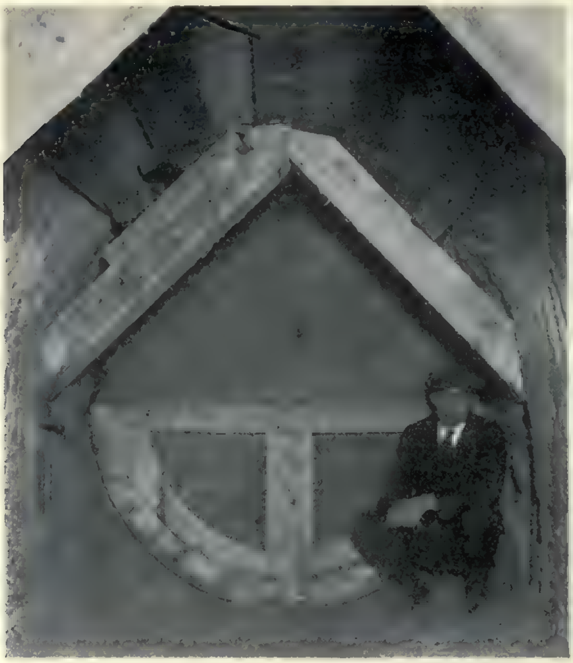


Fig. 4—Crutch timbering in a situation where there is all fine, yellow sand with a small percentage of clay. The tunnel crosses an old creek and the change is rapid between sand, gravel and boulders.

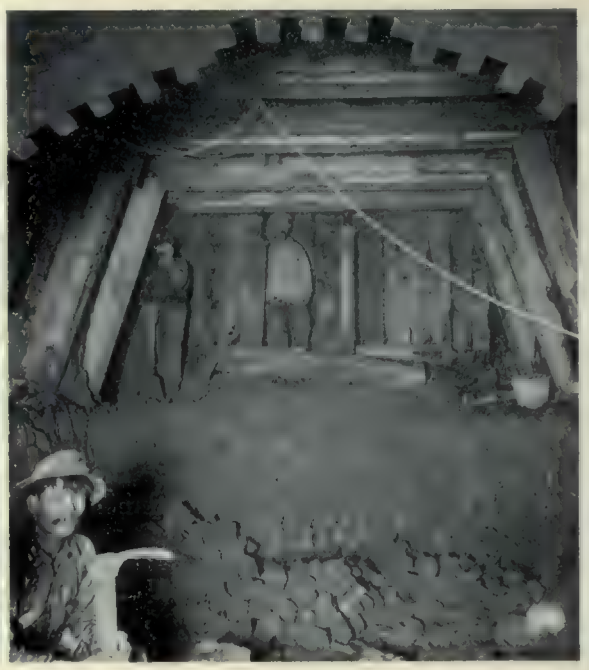


Fig. 5—Indicates how soil changes rapidly. In this case there is sand above the springing line with clay below.

Types of Timbering

When the tunnelling is commenced, should the material through which the tunnel must pass be fine sand, care should be taken to closely timber the crown to prevent the caving-in of this material. Otherwise, a greater pressure of air being required for the invert of the tunnel, than for the crown, the sand in the crown will dry out and pulverize, falling in a continuous shower of fine dry dust. Sometimes it is advisable, when this sand gets too dry, to shut down for a day or two, turn off the air pressure and allow the sand to settle and the moisture to return. In this type of work, the necessary timbering for construction will be either the needle-beam, Fig. 2, cap and leg, Fig. 3, or crutch method, Fig. 4, depending on the size of the tunnel and the kind of ground. If the ground is of a loose nature, either of the first two methods mentioned will be used, while in firm ground and if the tunnel is not too large, the crutch method is more suitable. Even where the tunnel is large and the medium through which it passes is loose material, it is seldom economical to construct more than 800 or 900 feet before new locks are built and possibly a new shaft sunk.

If the work is in a city, it is likely that several corners must be turned in this distance and therefore, the line should be tested. This is best done by driving a large pipe from the surface ahead of the work and on line, capping it and boring a small hole in this cap large enough for a plumb-bob line to pass through. The plumb-bob is then dropped through the pipe and the cap is turned until this hole is on line. Then we are all set and when the tunnel comes to the pipe, we can check on the line below.

Water in a Stratum Under an Impervious Layer

In the second case mentioned above we have water lying in a stratum under an impervious layer. Should this water be in quantity, it is likely that a vertical airlock will have to be built in the shaft in lieu of open cut, to be used only temporarily until such time as tunnelling has progressed far enough to build permanent horizontal locks. The vertical lock is not used longer on account of the difficulty of taking material in and out. There will likely be very little escape of air here unless this impervious layer has been punctured in the vicinity before, in which case the water will likely be above as well as below, and the problem then will be similar to the former one, until this hole is passed, with any variation depending on the size and number of the punctures. Should there be no former punctures, however, the volume of air required will be fairly constant and will depend on the size of the tunnel and the thickness of the impervious layer entirely and the pressure, too, which will vary little, will depend on the amount of head of water to be counterbalanced. The great difficulty, as in the former case, will be in the size of the excavation, for should the tunnel be large, the amount of pressure required to balance the water pressure in the invert will be greater than that in the crown.

The solution of this difficulty will be mainly in the design and method of construction, which will be dealt with later.

Where the Outlet is Larger Than the Inlet

The third case, where the outlet is larger than the inlet, is similar to the problem just described, with this difference that streams come in at a few points instead of the medium being saturated with water throughout. Usually the material through which the tunnel must pass is of a fine sandy nature, very compact and with a small admixture of clay. This material remains quite hard when water is absent and more often than not has to be removed by dynamite, but is easily puddled and worked up when water is present, will readily cave in and create a dead weight on the crown timbers. Generally a low pressure is all that is required to dry this material and there will be little escape of air.

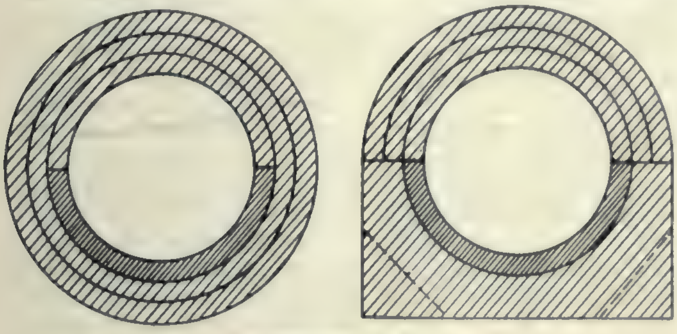


Fig. 6—Typical sections used in compressed air methods.

The fourth case is similar to the third, with the exception that we are more sure of the pressure required which will vary but little.

In the fifth case, where the tunnel crosses the channel of an old water course, the uncertainty will depend largely on the nature of the material composing the filling and the result will be a similarity to the first or second problems, except that this condition will be local.

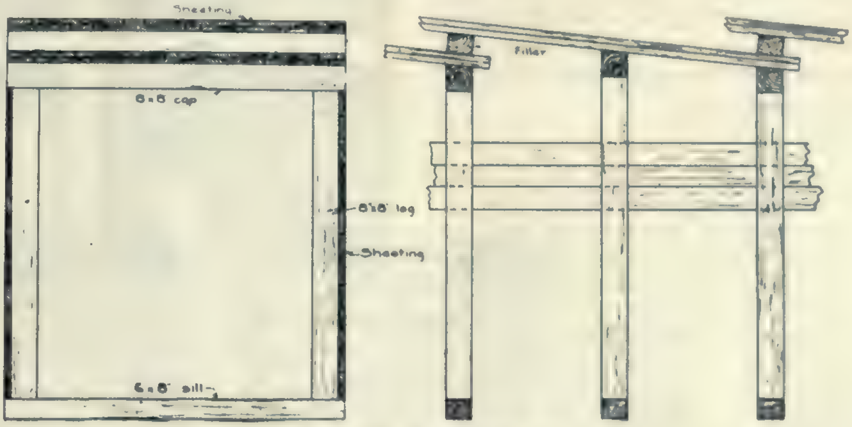


Fig. 7—Cap and leg timbering

As before stated, there are many variations of these problems. In each case it has been assumed that the tunnel lies wholly in the stratum dealt with, but, of course, the strata may be thin and change rapidly from one kind to another, (Fig. 5). Thus the tunnel may lie in several strata; hence the variations of treatment which must be dealt with locally.

Before proceeding with a discussion of timbering and design, it might be well to consider the effect of compressed air on the workman. In most cases, very little effort has been made to prevent injuries of a more or less serious nature to those who have to work in compressed air—in fact the possibility of injury resulting from it has hardly been considered. Of course, in places where very high pressures are used, measures are provided for giving first aid and rules have been drawn up preventing the employment of men who may not be physically able to stand very high pressures. But no general attempt has been made to estimate the permanent injury that may be caused to even the most healthy individual. Indeed, it will be difficult to know where to begin or end this problem and it should be made a special study. From observation it would seem that this is a very pressing need and one providing a great opportunity for investigation.

In all cases, it would be well to take steps to prevent the abuse of certain known facts. These present abuses are caused more by ignorance than a desire for gain. Permanent injuries are caused, as a rule, by long association with this work or long hours spent in this unnatural atmosphere, also by neglect to take certain precautions, such as taking the proper length of time to enter and come out of compressed air. A man who is working hard at, for example, mining or mucking, is not so liable to injury as one who does not sweat, for the former man opens all his pores thus providing a way of escape for the imprisoned air when he enters the normal atmosphere. It is suggested that a hot shower bath could be provided where compressed air is used and every man compelled to use it before entering the compressed air

Needle Beam Timbering

As stated before, the three methods of timbering generally used are the needle-beam, cap and leg, and crutch methods. These are the most efficient methods for this class of work. When the needle-beam method is used, a small cap and leg drift must first be driven ahead of the work, the caps of which must be above the outside of the future lining. When this drift is completed, the beam is carried forward into it. The rear end of the beam is blocked up from the finished invert of the tunnel until it is at a point near the centre. The front end is blocked up from the bottom of the drift, until it is at the approximate centre of the future tunnel. The beam then serves as a hub from which spokes or needles radiate for the support of the sheeting. The top spokes take the weight of the caps of the above mentioned cap and leg drift and the legs being removed, the excavation proceeds gradually until it is completed.

Cap and Leg Method

The cap and leg method, Fig. 7, is used generally in the case of tunnels where the sand is fine and wet and where there is not enough clay present to give the ground the consistency for using other methods. Of course, none of the timbering can be removed in this case, therefore, it is the most expensive method. Enough excavation is made to set up one set of cap and legs. Sheeting is then driven over the cap and the earth is excavated just behind the points of these planks until enough has been removed to place another set. The cap in this new set is placed low and the next sheeting driven over it, the rear ends of the planks being under the preceding cap, thus giving them always an upward angle. When this set of sheeting is driven ahead its full length, a filler is placed between the two lots. The tops of the legs are cut on the slant so that the cap always tilts upward and the sheeting then rests evenly upon it.

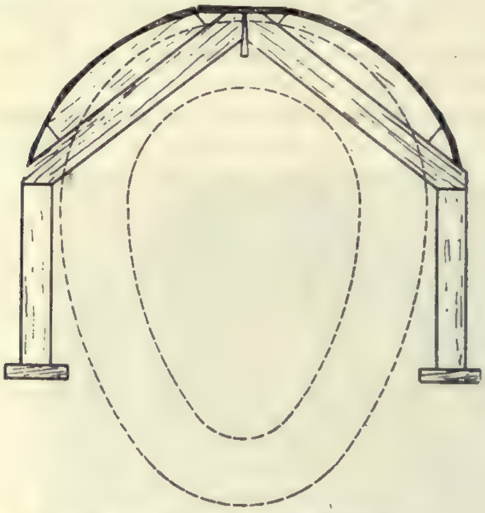


Fig. 8—Details of crutch timbering.

Crutch Timbering

The crutch method of timbering is used in tunnels where the ground is dry and requires only light sheeting and that in the crown. A narrow drift is driven the length of the required excavation and in the centre, the top corresponding with the top of the completed tunnel.. A plank is then placed in position in the crown, supported temporarily by screw jacks at the front end. The drift is widened slowly, enough to insert one plank at a time on each side. When the excavation is completed, timbers as shown in Fig. 8, are placed as often as is thought necessary for the support of the planks. These heavy timbers for the support of the sheeting are removed one set at a time as the masonry lining approaches them. One advantage of this method is that the lower half of the circle can be completed before any of the timbers are removed, The top half is then built and the sets are removed, the masonry taking the weight of the crown planks.

Types of Linings

In designing tunnels in these different classes of ground, we have a choice of four designs—the straight barrel-shaped lining, (Fig. 6), barrel-shaped with a square bottom, (Fig. 6), and the egg-shaped, with or without a square bottom. The straight barrel-shaped lining is probably efficient in all classes of ground, but in some cases where the ground is all sand and wet, it is advisable to build a square bottom and where the tunnel is large, to reinforce it if there is any possibility of the lining any time in the future being undermined in such a way that the wet ground will run out from under the lining.

Needle-Beam Timbering Unsuitable for Wet Sand

It should be noted in passing that where fine wet sand is met with, it is inadvisable to use the needle-beam method of timbering for the reason that as the needles or spokes supporting the overhead timbering are removed, the weight will rest on the green masonry, which, in turn, is very likely to spread, producing cracks both in the crown and invert. Cap and leg timbering is best for this class of ground. In a case where we have a solid bottom below the springing line, the needle-beam may be used to support the crown timbers in a large tunnel, while the crutch method may be used for smaller tunnels. In the case of a large tunnel in loose, sandy, wet ground, a higher pressure of air, as mentioned above, will be required to dry the invert than is required to dry the crown and sometimes this is difficult to obtain, in which case it might be advisable to vary the square bottom, if such is used, in such a way as to avoid taking out the corners and timbering the sides. A three or five sided bottom is suggested, (Fig. 6).

Preparation of Granulated Slag for the Manufacture of Building Tile

These illustrations show the water jet method of preparing granulated slag, now being used in hollow building tile by the National Slag Products Ltd., of Hamilton, Ont. A description of the process appeared in last week's issue.

WARNING

Subscribers and others are warned against giving subscriptions or paying money to two men by the names of Garin and Barnes. These men have recently been operating in the Maritime Provinces. One Garin was authorized to take subscriptions for Hugh C. MacLean Publications, but his methods were found unsatisfactory and he was discharged. Barnes was never given authority. Certain forms bearing the name Hugh C. MacLean, Limited, and used to facilitate them in obtaining money, were printed by them without our knowledge or consent.

Construction Activities in the Vancouver District

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Special Entrance Features in Vancouver Theatre

While the Entrance Fronts on a Main Street, the Auditorium is Located on Cheaper Property on a Parallel Street and is Reached by a Passage Elevated over Lane

Ingenious use has been made of a very narrow main street frontage by the builders of the new Capitol Theatre at Vancouver, B. C., in which a motion picture house of the first class has been added to the number of the city's theatres.

A piece of property of sufficient size for the proposed building was available on Seymour Street, which lies next parallel to Granville Street, where it was desired to have the main entrance. While Seymour Street is so close to Granville, which is the principal high-class shopping street, it is very quiet and no doubt the property mentioned as available was to be had at a price very much lower per front foot than it could have been obtained on Granville Street itself. As finally arranged the theatre, which is a very large one, was built on the moderate priced property on the back street, but a narrow frontage was secured on Granville Street, and a very handsome approach was built to the theatre at the back, opportunity being afforded by this means for a lavish display of the decorator's art in the architectural features of the interior of the passage, which presents a very impressive appearance.

A complication of the problem was the existence of a lane through the middle of the block, which could not be closed. This difficulty was overcome by a combination of ramps and stairways in the approach passage, which by the time the lane is reached has by this means attained a sufficient elevation to allow plenty of head-room for traffic in the lane.

New Highway Between Vancouver and New Westminster

Road, a Mile Long, Paralleling the Railway Entrance into Vancouver Forms Important Section of Intercity Route

A new artery of communication will be furnished between the cities of Vancouver and New Westminster with the completion of the new highway paralleling a section of the V.V. & E. Railway, this portion of which is known locally as the Great Northern cut, The Great Northern Railway Company being the owners of the line of railway over which several lines, including the Canadian National, find access to the terminal yards in the centre of the city.

This section of the new highway is nearly a mile in length and has been necessitated by the construction of the railway through that section of the city. To reconstruct the rectangular system of roads after the building of the railway would have involved an elaborate system of bridges, which would have been rather impracticable as well as out of the question owing to the great expense that would have to be incurred. Final settlement of the details of the scheme, however, was delayed through the war years, and it

The Capitol Theatre, Vancouver, B.C., is located on Seymour St., with an entrance on Granville St A long passage, elevated over an intermediate lane, connects the theatre with the street

Left:—New highway through east end of Vancouver. Inexpensive asphalt treated macadam is being used for paving at present.
Right;—40 ft. railway cut paraleled by the new road and which is the reason for its construction.

was only in 1921 that the plans were finally laid down and work commenced. Some six years ago bridges were built spanning the cut on all the streets running north and south, while two important east and west avenues, which could not be closed to traffic, were also bridged. Several of these structures are of permanent construction in steel and concrete, while all are integral parts of the ultimate scheme, which is shown in its entirety on the accompanying map.

Purpose of the Road

The object of the scheme is not only, as stated, to link up a new intercity route, but also to adjust the local situation so that convenient access may be had from all property to streets on either side of the big cut. The new road itself is on the north side of the cut, and on the south side communication has been provided by the expropriation of several short sections of property which with roadway constructed will link up the existing streets in such a manner as to provide fairly direct east and west communication. It was not considered necessary, however, to make the road continuous as on the north or down-town side of the cut, as the south side is almost entirely residential and through traffic is already served by a main highway with street car lines, shown as Broadway on the map.

The length of the diversion, which is under construction at the present time, is 5,700 feet, with a width of 70 feet between property lines. The grading has involved about 20,000 cubic yards of material, mostly gravel and clay, the work being done by the Great Northern Railway Company under the supervision of the city engineering department. Mr. F. L. Fellowes is city engineer, and Mr. W. Brand Young, A.M.E.I.C. has been directly in charge of the work on behalf of the city.

An 18-ft. rock roadway is being laid, consisting of crushed granite with topping of screenings. This is to be treated after rolling with a penetrative asphaltic compound, and will probably be surfaced with an asphalt mixture. Provision is being made for street car lines, which will bring the aggregate amount of paving up to about 17,000 square yards.

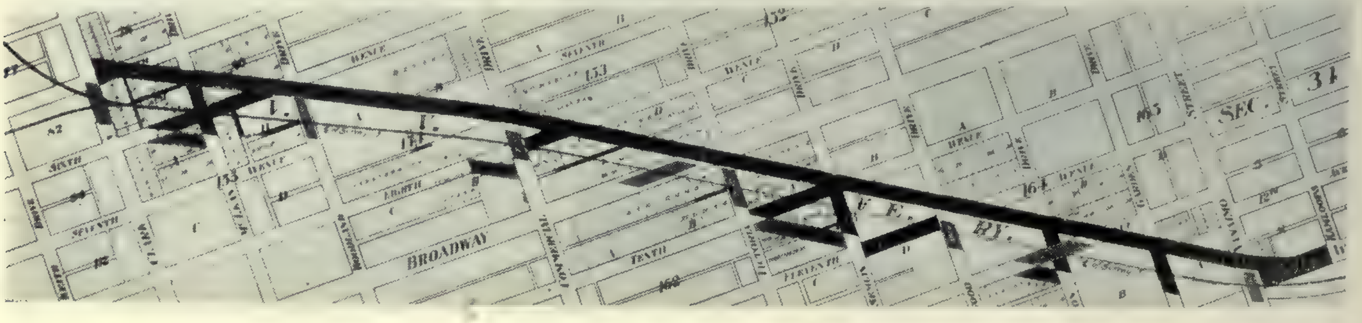
Fourth Unit Being Installed at Stave Falls Plant

Construction Operations Under Way for Completion of a 52,000 h.p. Development by Addition of Another Unit

Construction operations are under way in preparation for the installation of the fourth unit provided for in the original plans of the Western Canada Power Company's plant at Stave Falls, B. C. and it is expected that the unit will be in service early in June of this year. The powerhouse, which was designed for four main units, was first completed for two, and in 1916 the building was extended for the installation of the third and fourth units. The third unit has already been installed and is running, while when the building was extended, the intake gate and penstock for the fourth unit were erected in anticipation of the installation of the unit itself, which has now become necessary.

Each main unit consists of a 13,000 h.p. double horizontal turbine of the Francis type, built by the Escher-Wyss Co. of Zurich, Switzerland, direct coupled to a 9,000 kw., 3 phase, 60 cycle, 4,400 volt Canadian General Electric generator. Regulation is secured by governors of the oil-pressure type, the oil pumps being driven by individual impulse wheels.

The installation of this fourth unit will raise the rated capacity of the powerhouse to a total of 52,000 h.p. which is the economical limit. An additional development is contemplated, however, which would make use of the tailwater from the existing plant, and which with the available head would add sufficient power to more than double the capacity of the plant as a whole.



Route of new thoroughfare in Vancouver

Comfort Stations Under Construction in Vancouver

First of a Series Now Being Built Will Cost $16,000 and Will be of the Most Modern Type

Construction has just been commenced in Vancouver, B. C., of a public comfort station of the most modern type, which is stated to be the first of a number of similar undertakings to be put in hand as funds are available for the work. The present station is estimated to cost $16,000.00 and will fill a long-felt need in the central shopping district, which has had to depend up to the present, on the conveniences provided at the C.P.R. Station and in department stores, etc.

The location selected, where excavation is already in progress, is the corner of Hastings and Hamilton Streets near the site of the old court-house, which site is being reserved for the construction of a civic centre and city-hall. The comfort station building will be entirely below ground, and will be in two parts, devoted respectively to the uses of men and women. Reinforced concrete is to be used for the main structure, within which will be a lining of 4-in. hollow tile separated from the concrete by an asphaltic waterproofing course. The tile wall will support a finish of 3-in. x 9-in. white glazed tile, which is to be placed full height round all walls and finished at the top and bottom with a cove. The ceiling, which will conform to the grade of the sidewalk above, will be formed of a reinforced concrete slab supported on I beams of appropriate weight, which are to be cased in concrete.

The equipment, which is to be of the best quality, is largely standard, but special mention might be made of the provision of a special childrens' toilet, with low seat, in an extra large cubicle in which is also a bench for the attendant. It is also the intention to install sanitary electric air dryers in the place of a supply of linen or paper towels. These dryers, which have not as yet been seen in Western Canada, are in use in the public stations in Seattle and elsewhere and are exceedingly efficient besides being unquestionably sanitary. A pressure of the toe on a treadle at the base operates the control switch and directs a blast of air at high velocity on the hands. The air may be used hot or cold at pleasure.

Ornamental ironwork surrounding the stairways will also carry appropriate signs, which will enclose electric lights so as to be of service at night as well as during the day-time. A cast iron lamp standard between the two stairways will also serve as a ventilating stack. Heating will also be provided for, gas radiators being shown in the public rooms as well as in the attendants' rooms. A wrought iron collapsible gate will be installed at the bottom of each stairway.

Contract Bonds for Construction Work

The Owner---A Soliloquy

By A. E. KIRKPATRICK

General Manager, United States Fidelity & Guaranty Co., Toronto

I have $100,000.00 to spend on my factory, not a cent more, and if I could be assured that it would be completed for that amount I would proceed with the work. However, if through error of judgment or through lack of ability or through financial difficulties the contractor should fall down and I had to pay ten or twenty thousand more to complete the building, it might be impossible for me to finance the work, or my whole scheme of investment for profit may be turned into investment for loss, or I might be so hit financially by the extra charge thrust upon me to find my whole credit position seriously embarrassed even to the extent perhaps of miserable failure.

But a thought strikes me—perhaps I can get some guarantee that the contract will not exceed the estimate. I am told that for 1 per cent. a bond company will guarantee that the contractor will not fail, or that if he does, or falls ill, or suffers serious accident, I am still protected and can recover any loss.

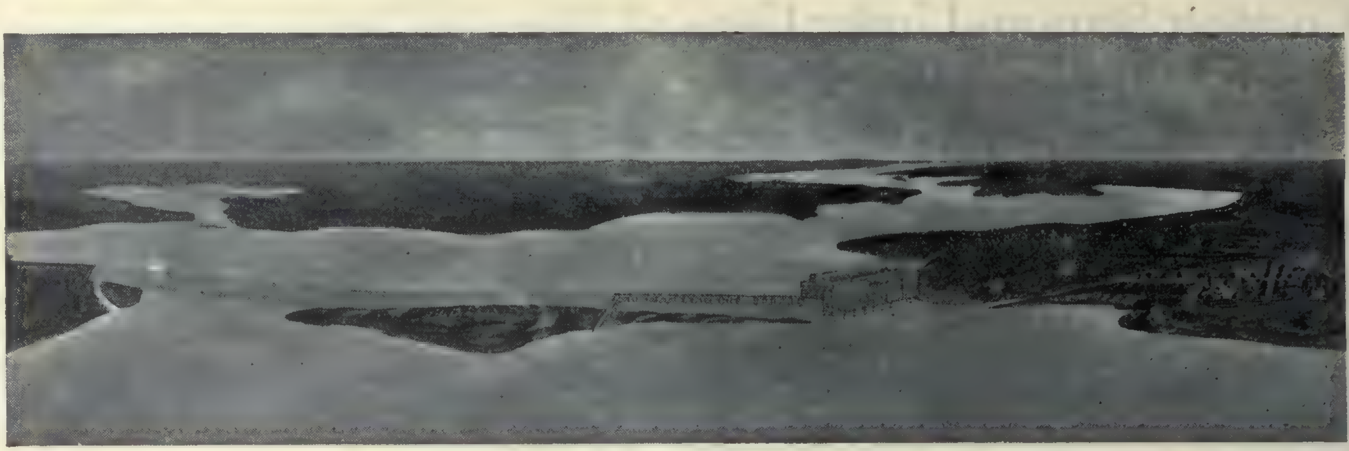
I have decided, therefore, to proceed, several friendly contractors have tendered—there is a difference in the figures I will admit—but I have decided that come what may my duty to my business, to my family, and to those dependent on me demands that I have a bond company's guarantee from my contractor before I sign up. If luckily the lowest tenderer gives the bond, I am better satisfied, but if by chance unknown to me he cannot give me a guarantee from a bond company, then I must surely choose the contractor nearest to the lowest who can, by giving me a surety bond, give me the absolute assurance that I shall sustain no loss—and cheerfully will I pay the premium which guarantees me safety and peace of mind.

Add Building Department

The firm of T. E. Rousseau, Ltd., engineers and contractors, 504-05 Quebec Railway building, Quebec, has added a department of building construction, under the management of Mr. A. O. Destremps. This firm has completed considerable road work on the Montreal-Mont Laurier highway and on the Three Rivers-Shawinigan Falls road during the past season. They are completing a new hill road in the city of Quebec. They are preparing for a busy season in all departments.

Filter Plant for Smith's Falls

The council of Smith's Falls, Ont., have retained James, Proctor & Redfern, Limited, Toronto, to make a full and comprehensive report on a filter plant from the local river or a pipe line and supply from Otter Lake, 8 miles distant. Smith's Falls has been ordered by the Provincial Board of Health to put its waterworks system in shape.



Showing General Scheme of Manitoba Power Company's Development

The Next Big Western Power Scheme

Manitoba Power Company Actively Developing Great Falls, Winnipeg River—Contracts Let for Two Complete 28,000 H.P. Units—Complete Capital Cost Will be less than $80 per H.P.

Active construction work is now under way on the Great Falls Development on the Winnipeg River by Manitoba Power Company Limited, after considerable preliminary study and investigation. Work is going forward rapidly and excellent camp quarters for the large force of men necessary for the work have been constructed, comprising up-to-date mess-halls and kitchens, bunkhouses and hospital, together with administration buildings and offices. A complete construction plant has been erected, including rock crushing plant, mixing plant, concrete chuting equipment, storehouses, machine, blacksmiths' and carpenters shops and a complete yard and track layout for the handling of the large quantities of materials involved in the work.

A standard gauge railway, 13½ miles in length, has been constructed, connecting the Canadian Pacific Railway tracks at Lac du Bonnet with the power site at Great Falls. This railway is now being extended a distance of three miles, from the power site to White Mud Falls, lower down the river. The road is well ballasted, is laid with 60 lb. steel and compares favorably with other branch line roads in this section of the country.

Over 1200 lineal feet of cofferdam, varying in depth from ten to thirty-five feet have been constructed, and in order to expedite the work a temporary boiler plant was installed and the power house site, enclosed by the cofferdam, was unwatered by steam pumps. Steam drills were also put in service for rock excavation.

A 60,000 volt double circuit transmission line, eighteen miles in length, supported on steel towers forty-five feet high, has now been constructed from a point on the Pinawa-Winnipeg line of the Winnipeg Electric Railway Company to the power site, and connection has been made to the City of Winnipeg Hydro-electric System's line for power supply during construction. This line will ultimately form one link of the permanent transmission system, connecting the new development with the existing water power plant on the Pinawa Channel, and with the sub-stations in the City of Winnipeg. Electric power was made available over this line early in February, and all the construction plant is now being operated electrically. A temporary transformer house has been constructed at Great Falls, which contains one bank of 600 kw. transformers and one bank of 1,500 kw. These latter transformers, while they are now being used for construction purposes, are primarily designed for station service use in the power house. Power is being distributed at 2200 volts and a double circuit wood pole line has been run from this transformer house to White Mud Falls, where a sub-station containing about 700 h.p. in 2200 volt motors operating compressors, derricks, etc. has been installed. With electrical operation at Great Falls, the work of rock excavation has been greatly facilitated, and to date approximately 30,000 cubic yards of solid rock have been excavated for the power house draft tubes and tail race. This constitutes about one-half of the total excavation required.

General Layout

The power house proper is located at Island No. 2, where the dam to be constructed will hold the head waters above the power house at Elevation 808, thus forming a pond or peak load reservoir of approximately 2,000 acres in extent, providing a deep, wide and extensive body of water reaching upstream a distance of five miles and flooding out the existing rapids, thus obviating the trouble so often experienced in these northern latitudes from frazil ice, which forms in swift, turbulent water.

The dam at Island No. 2 will raise the present water level forty-six feet, and investigation has disclosed the reach of the river below the power house to be from thirty to ninety feet in depth, this level being maintained by a rock reef across the river at White Mud Falls. By excavating a channel 200 ft. wide, 20 ft. deep and about 1800 feet in length through this reef, the entire reach of the river between White Mud Falls and the power site will be lowered ten feet or more, thus making a total operating head of fifty-six feet, for which head the turbines are designed. The rock excavated from this channel will be hauled by railway to the power site and used in the construction of the rock-fill dam across the East Channel, and will also supply crushed stone for the concrete.

At the site selected for this development the river is divided into two channels by an island, upon which the central section of the dam is located. It is possible, therefore, to close the West Channel by cofferdam, as has been done, passing all of the water through the East Channel. The gates and wheel pit openings in the power house in the West Channel, which will be completed first, can then be used to pass the discharge of the river while construction is under way in the East Channel.

The Dam

As shown on Fig. 1 the dam, from the west shore to the power house, will be of the usual solid concrete non-overflow type, approximately 750 feet in length with a maximum depth of seventy feet. From the end of this dam to the island the power house bulkhead constitutes the dam. A curtain wall along the upstream face of the intake walls of the power house, extending six feet below the forebay level, will prevent ice and other foreign matter from entering the wheel pits. Adjoining the easterly end of the power house a wing wall, one hundred feet in length, will extend up the river parallel to the current. In this section a skimming weir for discharging ice and other floating materials will be included.

The first 260 feet of dam on the island will be similar in design to the non-overflow dam referred to above. The next 400 feet will be of the overflow or free spillway type, with crest at elevation 808 and with provision for flash boards to raise the head water. Four steel sluice gates, 50 ft. wide and 30 ft. deep, will be located on the crest of the island. These sluice gates are designed to pass the full flow of the river under maximum flood discharge conditions. The section of the dam between these sluices and the easterly end of the island will be 200 ft. in length and of non-overflow section, similar in design to the west wing wall.

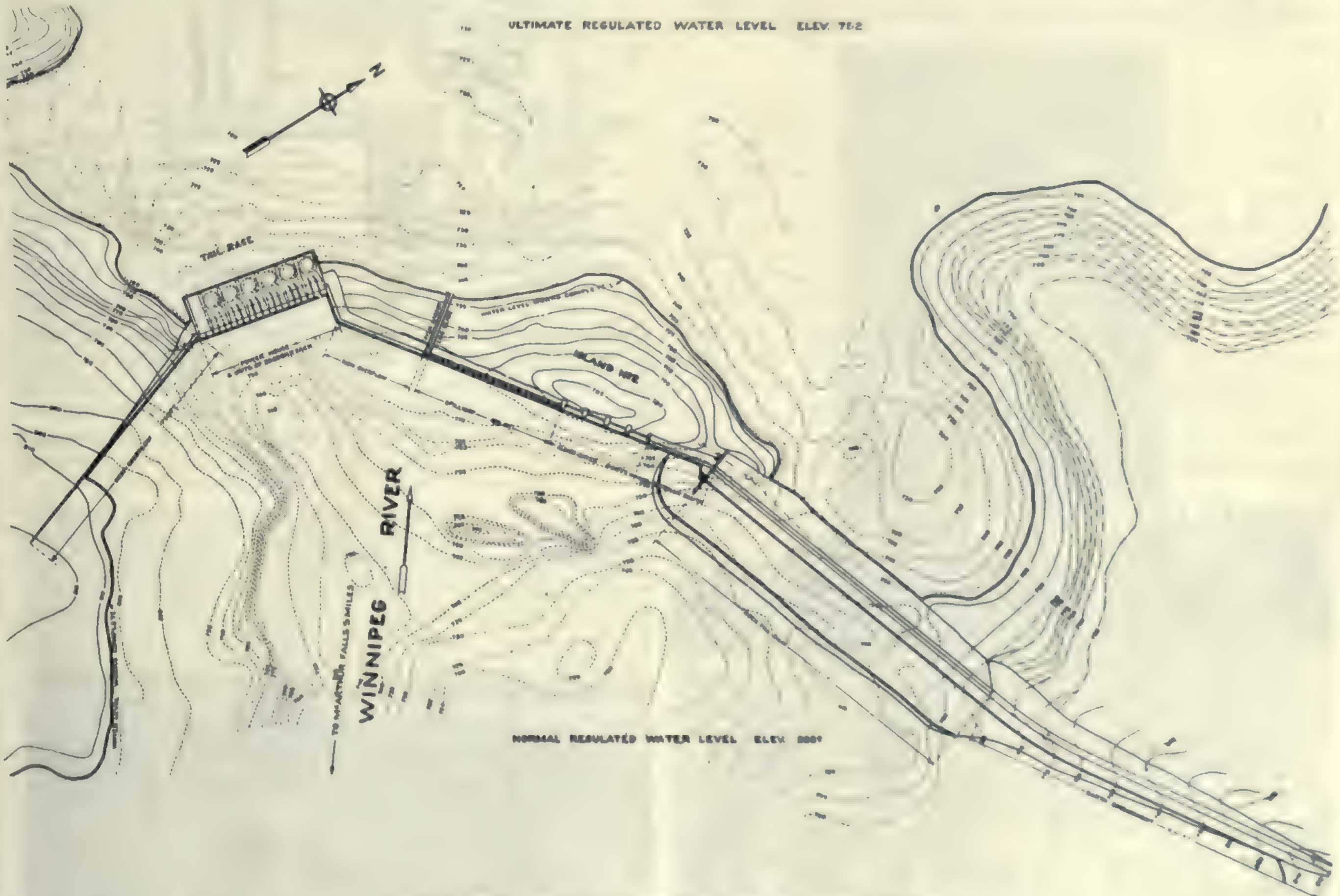
The dam across the East Channel will be of rock-fill section, 1000 feet long, and with a maximum height of seventy feet and crown ten feet wide. The slope of the rock will be one to one. The upstream face of this dam will be faced with graded material consisting of broken rock, crushed stone, gravel and clay. The clay blanket will be built to a slope of 2½ to 1 and will be ten feet wide at the crown, and to prevent sliding a rock toe-fill will be placed at the lower edge of the fill.

The section on the east bank, 1100 feet in length, will be an earth embankment, with twenty foot crown, built to a slope of 1½ to 1 on the downstream side and 2½ to 1 on the upstream side, and will contain a concrete cut-off core wall.

The Power House

The power house will be 110 ft. wide, 380 ft. long and have a maximum height of 145 feet. The foundations will be of reinforced concrete and will carry a structural steel superstructure with brick curtain walls provided with steel sash. The roof will be of gypsum block tile covered with standard tar and gravel roofing.

The power house proper will contain six vertical turbo-generators with the usual intake racks, stop-logs, head-gates, etc. At the entrance to the scroll case for each unit, three pairs of steel head gates will be provided. Gate openings will be sufficient to pass the flow required for each turbine at a velocity of approximately 4.5 feet per second. Stop-logs will also be provided to facilitate inspection and


ULTIMATE REGULATED WATER LEVEL ELEV.
N
TAIL RACE
ISLAND
WINNIPEG RIVER
NORMAL REGULATED WATER LEVEL ELEV.

General Layout of Dam and Power House, Manitoba Power Co.

maintenance of the gates. The screens, consisting of heavy steel bars, six inches apart and supported on a steel framework attached to the sub-structure, will be provided for preventing debris from entering the wheels.

Fig. 2 shows a cross-section of the power house, from which the relative arrangement of the main equipment can be noted. The switchboard and control room will be located on a gallery at the westerly end of the power house, beneath which will be located the governor and oil pumps, air compressors, water pumps and other auxiliary equipment.

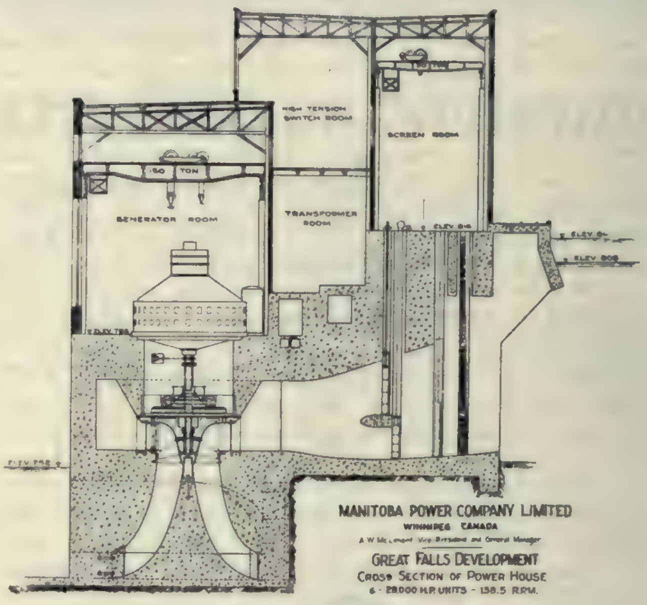
Initial Development

The initial installation is to include a power house building complete to accommodate three units, with screens, stop-logs, gates, operating mechanism, cranes, machine shop, heating and other necessary equipment for the successful operation of the plant. The substructure of the balance of the power house for the accommodation of the remaining three units will be completed only to such a point as is necessary in order that future extension can be made without unwatering expense.

The electrical installation includes two generators, the third to be installed in the space prepared when required, two banks of transformers and switching equipment for delivering the power to the outgoing lines. The dams and other permanent works will be constructed for the complete installation. The hydraulic installation includes the necessary turbines, governors, etc. for two units.

Hydraulic Equipment

Turbines:—The turbines will be of the single runner, vertical shaft, diagonal or propeller type, and will develop 28,000 h.p. when operating under ahead of fifty-six feet and running at a speed of 138.5 r.p.m. Under these conditions the guaranteed efficiency is eighty-seven per cent. The run-away speed of these turbines when operating under full gate opening and under an effective head of fifty-six feet will be about 315 r.p.m. The full weight of the revolving part of the turbine, including hydraulic thrust, but not including the generator field is about 600,000 lbs. The shipping weight of each turbine with its accessories is 725,000 lbs. The water enters the turbine through concrete scroll cases and will be guided into the movable guide vanes by individual stay vanes, imbedded in the concrete at their upper and lower ends. The stay vanes will be provided with foundation bolts and adjusting screws at the upper end for adjusting the cast iron pit liners before pouring the concrete. The runner will have six blades, cast separately, and securely bolted to the runner hub. The operating gear for the guide vanes will be of the "off-set" type, which differs from the usual construction in that the guide vane levers are offset from the radial position, and as the vanes close the levers turn in a direction still further away from the radial position, resulting in a toggle action. This action greatly improves the speed regulation of the unit, due to the fact that at large gate openings the movement of the guide vanes is greatest and the amount of this movement decreases as the vane closes. Furthermore, as the guide vanes close the torque increases, reaching a maximum value in the closed position where the hydraulic load is also a maximum. The links connecting the guide vane levers with the operating ring are of the double-shearing type.



Cross Section through Generator

Governors:—The governors will be of the double floating level type, with relay belt drive from the main shaft. They

Construction Views of Manitoba Power Company's Development are provided with hand control mechanism and the usual accumulator tanks, interconnecting piping, tachometer, etc., and electric motor for remote control. The governor will adjust the gates without "hunting" when the speed varies one-half to one per cent from normal, and they will be so adjusted as to open or close the turbine gates in not more than three seconds time. With full load change the time of gate movement is three seconds, and the percentage speed change, load off to zero is twenty-five per cent and load on from zero is thirty-two per cent.

Draft Tubes:—The draft tubes will be formed in the concrete and will be of the "Centercone" spreading type. The centercone will extend upward to an elevation just below the runner and the upper end of this cone will be provided with a cast iron cap which will extend through the lower end of the runner cap, forming a suitable pedestal for supporting the rotating element of the turbine when the thrust bearing is dismantled. Another advantage of carrying the centercone up to the runner discharge is that it avoids all flow close to the axis, where the tendency to form vortices is greatest.

Electrical Equipment

Generators:—The generators will be of 21,000 kw. capacity, of the vertical type, running at 138.5 r.p.m. This rating is based on full load temperature rise of 60 deg. C. by thermometer, or 70 deg. C. by thermo-couple, with surrounding air at 25 deg. C. The machines will have a guaranteed efficiency of 97.1 per cent and reactance of 25 per cent. The weight of the machine is 480,000 lbs. with flywheel effect of 10,000,000 WR^2.

These machines will generate three phase, sixty cycle, alternating current at 11,000 volts, and will be provided with 150 kw. direct connected exciters.

Thrust Bearings:—The entire revolving element of the unit will be supported by a Kingsbury thrust bearing mounted on top of the generator stator. This bearing has an approximate capacity of 950,000 lbs. at a speed of 138.5 r.p.m. and is provided with water cooling coils and the usual valves, thermometers and indicating devices which are customarily furnished with these bearings.

Transformers:—The transformers will be 7,000 kv.a. each, single phase, water cooled, 11,000/60,000 volts, with taps in the high tension winding to give 10,000 volts reduced capacity in the low tension windings. The guaranteed full load efficiency is 98.9 per cent, regulation at full load power factor 1.5 per cent and impedance approximately 9 per cent. The temperature rise at full load until constant is 55 deg. C.

The insulation test, high voltage to low voltage windings and core is 121,000 volts and from low tension windings to core 25,000 volts. The voltage across full winding is twice the normal.

Each transformer requires approximately 1,020 gallons of oil, weighing 8,800 lbs.; the weight of the transformer, less oil, being 25,000 lbs. The height from the leads is 172 ins. and from the cover 130 ins.; floor space covered being 93 ins. by 55 ins.

Switching Equipment:—Each generator will be connected directly to the low tension side of its transformer bank, without any intermediary oil circuit breakers or bus bars, which virtually makes each generator and its transformer bank one unit. The 11,000 volt cables from the generators to the transformers are carried in fibre conduits.

The high tension oil circuit breakers connecting the transformers to the high tension bus bars and line are of standard G.A.3 type, 73,000 volts, with interrupting capacity of 5600 amps., and each switch is provided with automatic overload trip.

General

The design of the plant is modern in every respect and in physical dimensions and quantity of water used the turbines are the largest for which contracts have ever been placed. The type of unit finally adopted is that recommended by a Water Wheel Committee consisting of five prominent hydro-electric engineers and the design of turbines was submitted by one of the largest Canadian turbine manufacturers, who has done very creditable work in developing a machine of such high speed and power output, resulting in a machinery cost of less than $14.00 per h.p. including turbines, generators, exciters, thrust bearings, transformers and switches. The capital cost for the initial installation, including all permanent works for the complete development is less than $80.00 per h.p. and the cost for the complete plant will be less than $60.00 per h.p. which is undoubtedly the lowest unit cost per horsepower yet recorded on this continent for a plant of this magnitude.

The plan of development is in accordance with the general scheme of the Water Power Branch of the Dominion Government, and forms the principal link in a chain of potential developments extending from Lake of the Woods to Hudson's Bay, aggregating several million horsepower.

The contractors for this work are Fraser-Brace Limited, who have successfully completed other large construction jobs of a similar nature, including the large dam for the International Nickel Company at Turbine, Ont., the La Loutre storage dam for the Quebec Government, the paper mill, dam and power house for Price Bros. at Chicoutimi, Que., and the Cedars Rapids Manufacturing and Power Company's development on the St. Lawrence River. In the execution of the above works the contractors have gathered together a very efficient organization which has been transferred to Great Falls, together with their complete construction plant, thus ensuring the successful construction of the Great Falls development.

Mr. F. H. Martin

Sir Augustus Nanton is president of the Manitoba Power Company Limited and Mr. A. W. McLimont is vice-president and general manager, under whose direction all of the work is being carried on by a loyal and efficient engineering and construction force. Mr. Julian C. Smith is supervising engineer. Messrs. L. J. Hirt, R. S. Lea and C. O. Lenz are consulting engineers and Mr. F. H. Martin is chief engineer and designer.

Standardization of Lumber Grades Favoured by Montreal Builders

Expressions of Opinion from Prominent Contractors Regarding the Establishment of Definite Standards in the Grading of Lumber as Recommended by the Montreal Exchange

At a general meeting of the Montreal Builders' Exchange, reported in the Contract Record of April 5, page 308, a brief discussion of the standardization of lumber grades was followed by the appointment of a small committee to study the subject.

The complaint was that, owing to absence of definite grades, contractors received from different firms lumber varying widely in quality, although nominally of the same character and ordered under the same classification. For instance, merchantable spruce will differ very materially according to the mill, wholesaler or yard supplying lumber. It is suggested that the compilation and enforcement of positive grades will enable the contractor to order exactly what he requires and what he will expect to receive, and will help the lumberman to the extent that he will be able to quote more accurately on definite specifications.

It is further suggested that it would put all lumbermen on an equality in competing for business and do away with any incentive to cut prices in the hope of securing orders and then making up for the low quotations by furnishing, say, a large proportion of culls, when merchantable was called for. Even allowing for some inevitable differences, owing to the manufacture of lumber by various mills, it is contended that the differences are so wide as to call for a system of grading which will establish something approaching uniformity.

The following interviews with representative contracting firms in Montreal explain their opinions in greater detail.

Says Montreal Gets all the Culls

A. Plamondon, of Arsenault & Plamondon, Limited, said: "Any one in the building trade in Montreal is impressed by the absence of any recognized standard in lumber used in construction. He is entirely at a loss in comparing the different prices quoted for this kind of material, either from retailers or wholesalers. What seems to be the height of unfavorable conditions is when lumber is ordered and unloaded at the works and then is refused by the inspector, architect or engineer. Unless the lumber merchant is willing to take it back, although no law can force him to do so, the contractor is obliged to dispose of this scrap lumber at a loss.

"In these times of efficiency, when standards are adhered to in any other class of building material, such as cement, sand, stone, steel, etc., we fail, at the first glance, to understand the causes which are keeping lumber, one of the most important materials used in construction work, from obtaining a recognized standard upon which all those concerned can reply.

"Inquiries from reliable sources in connection with this matter reveal the following facts: one of the main reasons for this state of affairs is a question of supply and demand, due to the poor quality of lumber employed in building construction. One other reason is the keen competition of buyers in their attempt to obtain the lowest prices without specifying any special quality of lumber. The market has developed to such an extent, that Montreal is recognized by the lumbermen of Canada and the States as the dumping ground of the continent for all kinds of cull lumber. For instance, all lumber sold in Toronto is merchantable lumber, where no local dealer will handle culls, whereas Montreal will absorb any amount of this trash in building construction. Were it otherwise culls could be employed only for crating and the like.

"To emphasize this point, I wish to mention the significant fact that on price lists furnished by mills from time to time, to dealers, all over the country, special attention is drawn at the bottom of the list that all culls will find a favorable market in Montreal, and will sell only $3.00 cheaper than the merchantable grades.

Must be Superman to get out Even

"The Montreal dealer today in order to meet competition must be an expert in buying cheap grade lumber and a superman in grading what he buys. For instance, let us call the retail dealer "A" and the prospective buyer "B".

"A" buys from the mill 100,000 ft. B. M. of lumber of the following specified width:—5% of 4", 10% of 5", 15% of 6", 15% of 7", 12% of 8", 10% of 9", 10% of 10" and 20% of 11" and over. It cost him say $32.00 M. ft. B. M. f.o.b. his yard. "B," the client, asks for a quotation on this lumber and informs "A" that dealers quoted him $30.00 M. ft. B. M. delivered on job. "A," to meet competition, will have to juggle with his 100 M of lumber recently bought, and if he is an expert in the game will arrange his lumber in the following manner to return him a good profit:—He will separate prices in the following way:—His 11" and over at $40.00, 10" at $37.50, 9" at $36.00, 8" at $33.00, 7" at $32.00, 6" at $30.00, 5" at $29.00, 4" at $25.00. Then "A" will quote "B" a price of $29.00 M and will deliver a large proportion of 4" and 5" and mix a small percentage of 6" and 7"."

Continuing, Mr. Plamondon said: "The Montreal dealers are not to blame for this state of affairs as they have to meet unfair competitions. They know that it would be to their advantage if lumber could be graded to a recognized standard, which would be accepted by the interested parties such as the building contractors, architects and engineers. The lumber merchants would then be on a fair level when they quoted prices for lumber with definite recognized standards, and furthermore by selling only merchantable lumber they could reduce their turnover by half, and make as much profit in proportion to what they make at present.

"There is no doubt that it would be to the advantage of everyone concerned, especially to the wholesalers, who could base their quotations on something definite, if this question of grading lumber was standardized, and one way to arrive at this would be to specify the width of lumber when asking quotations.

"To obtain the standardization of lumber we suggest that the Builders' Exchange of Montreal form a special committee for a study of this question of standardization of lumber, and officially ask the Lumbermen's Association, the Architects' Association of Quebec, and the Professional Engineers' Corporation, to submit their opinions upon this subject. Furthermore we think that the Builders' Exchange should ask those in charge of the Forest Products Laboratories, to make a special study of the question; we believe this bureau, which is composed of specialists, and which has obtained interesting developments in certain lines, would be of great help.

"The construction industry is deeply interested in this matter and is anxious to receive any suggestions regarding the proposed plan, and will welcome any comment that will ensure enlightenment on the matter," concluded Mr. Plamondon.

Should Get Grade He Pays For

K. D. Church, president of the Montreal Builders' Exchange ventures the following opinion: "We want some means by which the contractor can make certain of getting what he orders. Under present conditions he is not sure that he will get the grade he pays for. The difficulty is not with the larger mills, but with the smaller mills, where apparently little or no grading is done. You will order say merchantable stock from one mill, and the same thing from another and find that there is a wide difference in the quality. The reputable firms will supply reliable lumber—they grade it, and if one firm can do this there is no reason why others cannot do the same. As regards orders given to the yards, I find that as a rule the goods come up to what has been ordered. In one instance I ordered 2 in. lumber from a small mill and then found that it varied from 1½ to 2½ inches. The main trouble, however, is with firms who supply the cheaper grades of lumber. The idea is to secure certain standards under which we can order and know exactly what we are to expect. This will not only be a good thing for the contractors, but for the lumbermen, who will have definite instructions as to what is ordered—and expected.

"In the case of hardwood flooring, one firm from whom I buy can be relied upon to send what is ordered, but another firm will give the quality but the lengths are wrong—yet both firms have quoted on the same specifications. We want to get together in order to put this matter on a basis which will help the contractor and lumberman, and do away with disputes regarding the quality of the lumber ordered and supplied."

T. A. Somerville, manager of E. G. M. Cape & Co., Ltd. states: "This is a matter for the lumber firms, in so far as drawing up standardization rules is concerned. Our experience is that the only way to obtain what is ordered is to return the lumber if it does not come up to expectations. Naturally there will be some variation but good firms as a rule, supply according to orders."

H. C. Johnson, of the H. C. Johnson Co., Limited, gives his opinion as follows: "We have found great variation in the lumber received from different lumbermen, although the orders have been for identical grades. The only way to get satisfaction is to return the lumber if it is not up to expectations. Probably the establishment of grades would be of considerable value, but it would still be up to the contractor to see that he receives what he pays for. Grades are no protection against the dishonest lumberman or against any other class of trader. Comparatively few contractors know much about lumber and it might be a good thing if they would obtain more knowledge as to the various classes."

Douglas Bremner, of Norris, Bremner & Co., Limited states: "I think that the suggested grading rules would be of value to the contractor. Our experience has been similar to that of other contractors in ordering lumber—a considerable difference in the same class of stock according to the source of purchasing. Our complaint is not so much as to quality but as to sizes. In calculating the strength of certain work we order certain sizes of lumber; sometimes we find, however, that either the stock is too narrow or too thin, with the result that, if used, the estimated strength of the work would be lessened. Moreover, we should be paying for more lumber than we received. Our experience is that it pays to buy good lumber, even if the cost be higher, as good lumber is the cheapest in the long run. Of course, we regret any lumber which does not come up to what we order, but at the same time we would welcome any method which would lessen the chances of dispute."

Program of the American Water Works Association Meeting

The American Water Works Association will hold its 42nd annual convention in Philadelphia on May 15-19, with headquarters at the Bellevue-Stratford Hotel. The program has been arranged to include something that will interest all classes of membership, from the foreman to the most technical expert, and is as follows:

Monday, May 15

Registration, group meetings, committee meetings and in the evening the President's Address and an informal reception.

Tuesday, May 16

Forenoon—Business and reports of standing committees; Philadelphia Water Supply, Present and Future, by G. W. Fuller; Fire Prevention and Fire Protection in Relation to Public Water Supply, by F. C. Jordan.

Afternoon—Development of the Schoharie Water Shed, Catskill Water Supply, by J. Waldo Smith; The Hetch Hetchy Water Supply, San Francisco, California, by M. M. O'Shaughnessy; Construction of Loch Raven Dam, Baltimore, by Wm. A. Megraw; Twenty Years Filtration Practice at Albany, N. Y., by G. E. Willcomb; Election of members of nominating committee.

Evening—Water Works Manufacturers' Association Program; Moving Pictures and Short Paper Dean Control Valves, by Peter Payne Dean; Underground Leakage, by Thomas F. Wolf; Pneumatic Pumping, Up-To-Date, by John Oliphant.

Wednesday, May 17

Forenoon—Report of Committee on Standard Forms of Contract; report of Standardization Council; report of Committee on Industrial Wastes; Problems in the Reforestation of Water Sheds, by George R. Taylor.

Afternoon—Trip on river, 2:30 to 5:30.

Evening—Some Observations Concerning Wood Pipe, by J. W. Ledoux; report of Committee on

Standard Specifications for C. I. Pipe; Experience with Cast Iron Pipe for Pressures Higher than Allowed by Standard, by C. E. Inman; Centrifugally Cast Iron Pipe, by Peter Gillespie.

Thursday, May 18—Superintendents' Day

Forenoon—Water Chlorination Control in Virginia, by L. H. Enslow; report of Committee on Physical Standard for Distribution Systems; Air and Relief Valves, by M. M. Borden; Instances of the Value of a Sanitary Survey, by W. P. Mason; Causes of Failure of Cast Iron Pipe, by F. A. McInnes; topical discussion of breaks in water pipes and other subjects.

Afternoon—Equipment and Shop Facilities, by George E. Cripps; Present Day Tars for Pipe Coating, by W. R. Conard; topical discussion.

Evening—Industrial Water Supplies, by S. T. Powell; Reciprocating Pumps, by David A. Decrow; Turbo-Centrifugal Pumps, by Richard Waller.

Friday, May 19

Forenoon—Joint Session with the Chemical and Bacteriological Section; Plant Control of Chlorination, by Frank E. Hale; Responsibility of Water Works Superintendent to Prevent Tastes and Odors due to Microscopic Organisms, by W. W. Brush; Further Notes on Chlorine Control at Grand Rapids, Mich., by W. A. Sperry; Removal of Odors by Aeration, Filtration and Other Practices, by Norman J. Howard; Recent Developments in Chlorination, by Wm. J. Orchard.

Afternoon—Report of Committee on Meter Schedules; Steel Pipe, by T. A. Leison and G. A. Elliott; Balancing Reservoir, by Wm. A. Megraw.

Thursday, May 18

Afternoon—Water Softening by Base Exchange, by Edward Bartow and G. C. Baker; Report of Committee on Standard Methods of Water Analysis; Report of Committee on Collodial Chemistry in Relation to Water Purification; Report of Committee on Testing Materials, Lime Specifications.

Friday, May 19

Afternoon—Symposium on tastes and odors; Effect of Wastes Oil Refineries on Operation of Filters, by H. E. Jordan; chlorine treatment, general discussion; Tastes and Odors from Decomposition of Organic Material, by F. Holman Waring; Reaction of Culture Media, by George C. Bunker and Henry Schuber; Chlorination Prior to Filtration, with Reference to Efficiency, Economy and Removal of Excess Chlorine, by Norman J. Howard.

Hollow Tile Saves Sixteen Story Building From Destruction by Fire

The Office Building of the C.B.&Q. Ry. in Chicago was Gutted by a Severe Exposure Fire but the Steel Work Came Through Unharmed as a Result of Tile Protection.

On the night of March 14-15, a very severe exposure fire gutted the upper half of the 16 storey office building of the Chicago, Burlington and Quincy Railroad Co., Chicago. The fire originated in the block directly east of the C. B. & Q. building and the fire swept across an 80 ft. street, the unprotected street-front windows, plain glass and wood sash and frames of the C. B. & Q. building offering no resistance to the entrance of the flames. From an engineering and construction point of view the behavior of this building is interesting as it shows how the tile covering of the steel frame adequately protected the columns, beams and girders.

In this connection the following letter is of interest as it indicates how the tile stood up. It was sent to the National Fireproofing Co. of Canada, Ltd., at Toronto by Mr. Scott Russell, manager of sales, of the National Fireproofing Co. at Chicago, who made a thorough investigation of the building after the fire.

The C. B. & Q. building is sixteen stories in height, and through radiated heat from adjoining structures, all floors from the ninth up were gutted. Another floor which could be considered the seventeenth, but only covering one-half the area was untouched by flames. On a level with this floor is elevator machinery that was also untouched, making possible the operation of all elevators. This building was separated from the fire by the width of Canal Street, but the fire burned so fiercely in the Austin building that the heat caused the ignition of the C. B. & Q. building. The fire chief who accompanied us, and was at the fire, states that at no time during the blaze did any flames touch the C. B. & Q. building.

Intensity of the Heat

Before taking up the tile construction, it will be well to give an idea of the intense heat that existed during the fire. The glass in the windows, in many instances, ran like water, and in others fell into folds like cloth. Mullions warped and shed the terra cotta facings; steel filing cabinets and shelves warped and twisted and the contents were destroyed. Safes throughout the building became so hot that the contents of each was reduced to ashes. All metal throughout these floors suffered.

The floors of this building are constructed of 15" and 16" Natco arches with end constructed butts, and all are intact, but in possibly 10% of the area the bottom shells fell out. It is possible that many more are loose and will have to be removed. But in any event the arches served their purpose by protecting the steel, as there are no indications of any warped girders or beams. The girders from column to column drop below the ceiling line a few inches but all the covering was found to be intact and the girders apparently unharmed.

Partitions having borrowed lights were destroyed, but partitions extending from floor to ceiling were found intact, although in rather a shaky condition, due to the burning out of the mortar joints. As a whole, the tile was in fairly good shape, but there were partitions that were cracked by the action of the flames and the expansion of air in the cells. The partitions having borrowed lights simply fell over after the frames were burned out. The columns are covered with concrete and pipe chases are of tile. This concrete covering protected the columns very satisfactorily, and there is no indication of deterioration through the fire.

Tile Enclosed Wells Prevented Spread of Fire

The reason that the flames did not spread throughout the building is that all elevator and stair wells are enclosed by the partitions with metal doors. This construction prevented drafts through these openings and thus prevented the spread of flames. These stair wells and elevator enclosures are in perfect condition, and although the glass in the doors melted, the wooden hand rails on the railings of the stairs were not scorched. During the height of the fire the fire chief mentioned made several trips up and down the stairs and watched the fire from behind the doors. He stated that although the interior of the stair wells was extremely warm, it was not unbearable.

It is apparent that each floor ignited individually from the radiated heat, as the fire did not pass through the stair wells or the elevator shafts, and certainly was not conducted through the floors. Each floor burned out independently and this is borne out by the fact that the eighth floors does not bear any indication of fire and neither does the half floor on the top. On the floors that were burned out there is not a sign of any wood. Sleepers burned out of the cinder concrete fill and all frames were consumed entirely. Everything combustible was reduced to ashes and everything in metal was reduced to scrap.

The terra cotta and enameled brick on the exterior of the building suffered severely. Some was damaged by expanding steel, but for the most part, the terra cotta apparently suffered through air expansion within the cells. Many pieces of terra cotta were dislodged through failure of metal hangers and the enameled brick in the court pealed and at some points small sections of the wall fell.

The writer believes that this fire shows very conclusively the value of hollow tile as a fireproofing and protection for steel. Had it not been for this protection, unquestionably the steel throughout the gutted floors would have collapsed as did the steel forming the elevated structure close by. The rails and steel girders of this structure were bent like wire and some of the girders collapsed and fell to the street.

The other structures that were destroyed, were as the writer understands, of two types of construction, ordinary mill and slow burning. There is nothing remaining of these except a few walls.

An illustration of the building appears on page 25 of this issue.

Treated Bridge Timbers Have Long Life

Experience with Creosoted Wood on the Sante Fe System—40 Year Life Seems Possible—Troubles with Treated Timber and Methods of Overcoming Them

By A. F. ROBINSON

Bridge Engineer, Atchison, Topeka and Santa Fe Ry., Chicago

Before the Western Society of Engineers and American Wood Preservers' Association

The first creosoted piles on the Santa Fe System were used in 1875 in an open-deck pile bridge across Galveston Bay. It was rebuilt in 1895. When the Causeway was finished the piles in the later bridge were removed and the larger portion of them were used again in pier foundations. The first creosoted ballasted-deck pile bridges were put into service late in 1899. The same season we used creosoted timber flooring on a ballasted-deck steel bridge at Los Angeles. When the joint track elevation bridges were built in Chicago creosoted timber flooring with waterproof covering was used for supporting the ballast. From 1900 the use of creosote increased rapidly and by 1908 almost all timber used in bridges was creosoted.

Creosoted ballast-deck timber bridges from 16 to 20 years old seem to be in perfect condition and give promise of 15 to 20 years more. These may, therefore, be considered as permanent structures. Some 38 per cent. of all our bridges, which have a total length of 188 miles, are ballast-deck and almost 50 per cent. are considered permanent structures. Based on main lines, only 68 per cent. of all bridges have ballast decks. No open-deck bridges of any kind have been built on our main lines during the past 10 years, except after washouts or burnouts.

Troubles With Creosote

Creosoted-timber bridges had not been in service long before we found that there were many things to be learned about cutting, handling and curing before treatment; also handling the treated material and building the bridges.

Some of our troubles and the method of overcoming them may be worth recording. During 1909-1910 we had many complaints about rotten piling on our Beaumont division where timber seems to decay more readily than on any other part of our lines. A few miles east of Cleveland, Tex., is an experimental section, where we are trying out all kinds of treatment on ties, fence posts, etc. This section was taken because the soil and climate seemed to be especially adapted to produce rot in timber, both treated and untreated. I spent about four weeks going over this division, examining every pile bridge in the closest detail. The complaints were well founded. I found at least 2,000 piles that were rotting badly. The piling and timber used were treated in commercial plants from 1900 to about 1907. Up to that time no rules had been made covering the time the material was to be left in the woods after cutting and the time it was to be cured before treating. Many piles were treated which should have been culled. They were left in the woods several months and the material had commenced to decay before it was taken to the treating plant. In cases of this kind treatment is wasted. In many cases perfectly green piling and timber were treated.

Piles after driving in the bents are sawed off for capping. Our plans called for the application of hot creosote to these freshly-cut surfaces before the caps were applied, but a large percentage of the piles had begun to fail at the caps. Inside a layer or ring of sound creosoted sapwood would be a ring of untreated sapwood which was rotting very rapidly. The caps were 12 in. wide and the piles varied from 12 to 18 in. in diameter, leaving a portion of the pile head projecting beyond the sides of the caps. In some piles I could put a 4-ft. rod down in the rotten sapwood between the outer creosoted ring and the inner heartwood. In many cases much of the load was being carried by the outer creosoted ring of sapwood and but little load by the heartwood. In other cases, rot started at or near the ground surface. Decay also commenced in holes bored for sway-brace bolts and for other purposes. It would start wherever the creosoted surface was disturbed or bruised deeply.

Our men had the unfortunate habit of chamfering the sides of the piles at the cap so that they would drain. Frequently they would cut out large chips or sections from the side of a pile in order to make the sway-braces draw straight. In every case of this kind decay seemed to start very promptly as the cut in the timber usually extended through the creosoted layer. Careful study seemed to show that the cause of decay was due to leaving the heads of the piles or some other portions unprotected or untreated.

Pile Driving Caused Trouble

Another source of trouble was the driving of the piles. I found many cases where the heartwood had been broken loose from the sap, due to the fact that the blow from the hammer was being delivered into the pile over an area of less than one-half its surface. We overcame this difficulty by providing a driving head which rests squarely on the head of the pile and was so arranged that the blow from the hammer must be distributed over the entire surface of the pile.

As a remedy for the above troubles we cut down the decayed piles to good solid material and inserted framed bents or blocking of varying heights. When the piles were sawed the freshly-cut surfaces were treated with three or four coats of hot creosote mixed with heavy road oil. A sheet of some kind of prepared roofing was then applied over the fresh coating and the creosoted-timber bent put into position and drift-bolted to the piles. These repairs were made more than ten years ago and up to the present we have not been able to detect any more indications of decay.

When we cut these piles the cross-sections were examined very carefully and it was found that the creosote had penetrated the piles irregularly. On one side the treatment would be almost as thin as a sheet of paper and on the other side it might be 2 in. thick. We concluded that this unevenness was due to moisture in the piling, which resulted from the steaming and the improper seasoning.

When we opened our own treating plant at Somerville, Tex., all material was carefully air cured and no steaming of any kind was done in the treating process. As a result we have been able to get a very uniform penetration of the creosote. On the other parts of the system we have had very few piles fail at the caps, but where the trouble has occurred it has been overcome in the same manner as noted for the Beaumont division.

Examination of the stringers in ballast-deck bridges, which had been steamed in the treatment, showed a similar condition to the piling, but it was not so extensive. We have in a very few cases found some of the outer stringers decayed on the upper surface, as a result of the irregular penetration of the creosote. Where the timber is air seasoned and the treatment is applied without heating we have not had any trouble from decay in southern pine.

As a result of our trouble from rotting of piles at the caps we made quite an extended test on a field treatment of piles when cut for caps. With our first apparatus we were able to get ⅜-in. end penetration of the creosote. Several first-class creosoted piles were cut into lengths of about 3 ft. and also a similar number of untreated piles which were reasonably well seasoned. A part of these short creosoted specimens received the end treatment with our pressure apparatus. The other samples were painted with various kinds of preserving material and also several kinds of R. I. W. paint. After the coatings had properly dried these short pieces of piling were set up in a trench in the ground on our right-of-way 2 miles east of Cleveland, Tex. These pile butts were set 18 in. out of the ground, in an exact line and at the same elevation. A cap 12 in. wide and 4 in. thick was placed on top of the row of pile butts so that the test would be relatively the same as in the bent of a pile bridge.

We have examined these pile heads annually for eight years past. At present the samples of creosoted piles having pressure treatment on the ends and several of those receiving brush coatings on the ends are still in good condition. These investigations lead me to feel that a brush coating of hot creosote, of Reeves Wood Preserver and Toch's R. I. W. paint will protect the freshly-cut head of creosoted pile for a long time. As yet I am not certain as to whether it will be necessary to use the pressure treatment for the ends of piles since the brush coating seems to be giving extremely good results. The application of the brush coating will cost considerably less than the pressure treatment.

Rules for Handling Timber

Investigations made seem to show that the following rules in handling timber at the treatment plants must be adhered to absolutely:—

1. Treated timber must not be cut, bruised or handled in a rough manner. Grab hooks or dogs should not be used in handling the material, unless the holes made by the hooks are carefully plugged with creosoted pins.
2. The driving of piles must be done with a hammer which will not split them or break the sap loose from the heartwood.
3. Any cut surface or bored holes must be carefully treated with hot creosote and the holes plugged.

Where solid stringers are used in a ballast-deck bridge without any cross planking it is necessary to make end cuts on some of the sticks on account of the variation in panel lengths of bridges due to driving of piles. These freshly-cut ends must be thoroughly coated with creosote before the stringer deck is placed. A few years ago the Southern Pacific Lines in Louisiana and Texas removed the decks from 15 or 20 pile bridges which had been in service about 25 years. These decks were made of a solid course of 12 x 12-in. timbers and were removed because they were getting too light for the power used. Examination of these stringers after being removed showed that they were in perfect condition as concerns decay, except where they had rotted in from the ends which had been cut after creosoting.

In open-deck timber bridges the stringers and ties are untreated, but for some years past the ties on open-deck steel bridges have been creosoted. The ties are always run through a surfacing machine and brought to exact depth. While Oregon fir loses quite a percentage of its strength as a result of steaming or boiling during treatment. we have had no stringers break under traffic.

The Contract Record's

Weekly House Suggestion No. 17

The subject of this week's house suggestion article is a departure from the usual in that the residence illustrated is of frame construction. It is built along colonial lines and although simple, it is dignified in exterior appearance. Wide channel siding comprises the wall covering, the entire design being typical of the early New England home.

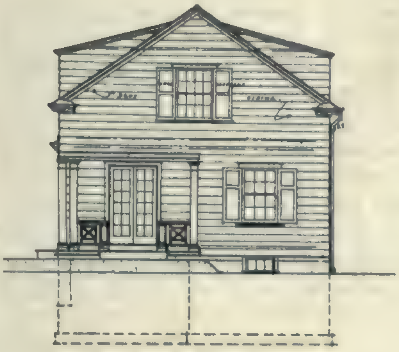
The house contains five rooms, with living room, dining room and kitchen on the ground floor and two bedrooms above, as shown on the accompanying floor plan sketches. The living room is a large, bright room, 11′ 6″ x 16′ 6″, which opens through double French doors directly on the front porch. As suggested on the plan, this room may be equipped with fireplace and nook for a bed davenport. There is an entrance from the side to the hall at the end of the living room and the stairway to the bedroom flat is located in this hall. The feature of the dining room layout is the convenient access from porch, living room and kitchen. There is a rear entrance to the kitchen, which room is 10′ x 11′, exclusive of the pantry at the rear. The pantry, in addition to ample space for shelving, provides for a refrigerator which may be iced from the outside.

The upstairs plan provides ample room for two large bedrooms and bath, all conveniently located off the hall.

The basement plan, as illustrated, is under the entire area of the house, with the exception of the porch, and provides for drying room, laundry, coal storage space and heating plant accommodation.

The dimensions of the building are 28′ x 24′ with an area 675 sq. ft. Residences of this type cost from 30 to 35 cents a cubic foot, depending on locality and the details of construction, the lower figure being possible of realization where labor costs are low and where a simple trim and hot air heating, instead of hot water, is used.

This house was designed for the National Lumber Manufacturers' Association.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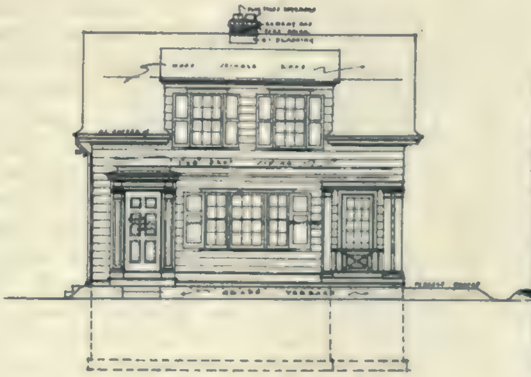
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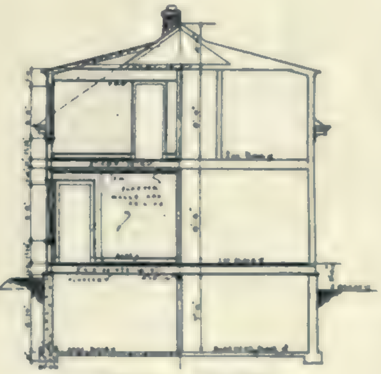
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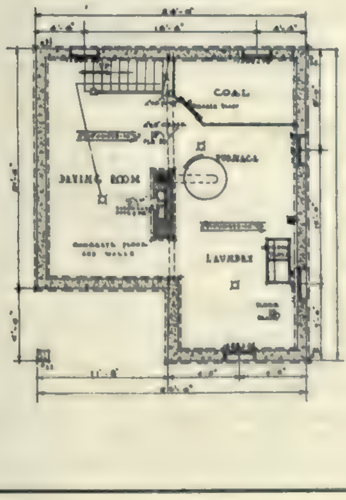

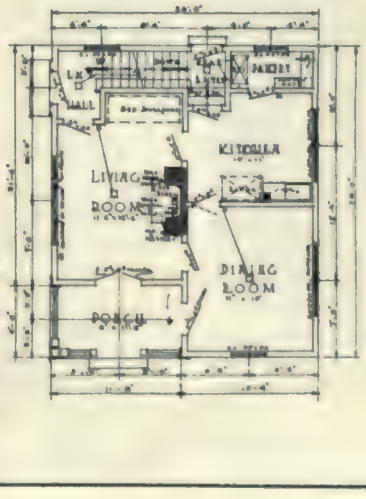

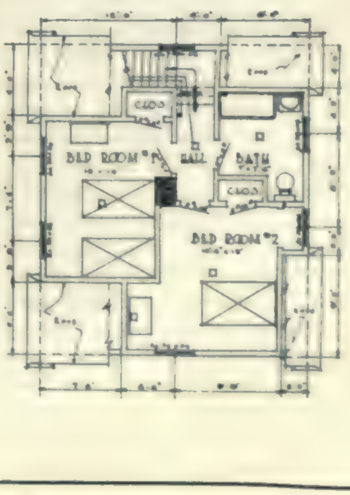

Toronto Contractor Awarded Roofing and Metal Work of Mount Royal Hotel

The roofing and sheet metal work of the Mount Royal hotel, Montreal, has just been let to the Carmichael Waterproofing Company, 918 Palmerston Ave., Toronto. This firm has completed similar contracts on numerous large buildings from coast to coast. A built-up Barrett specification bonded roof will be installed on this hotel which will be approximately 70,000 square feet in size.

Mainly Constructional

East and West—From Coast to Coast

The Barber Asphalt Paving Company is in future to be known as the Barber Asphalt Company. There is no change, however, in the organization of the company.

Toronto's 34,000,000-gallon water reservoir at Reservoir Park has been emptied for the purpose of installing a new piping system to increase the supply of water available from this source. It was originally intended to carry out this work in 1905, piping being bought at that time for the work, but the undertaking has been delayed from year to year. It will be gone ahead with now, however, and should be completed within six weeks time. Advantage of this opportunity is being taken to give the huge tank a thorough cleaning out.

This year at the Canadian National Exhibition, Toronto, will be known as "Prosperity Year" and preparations are being made to make the 1922 fair the biggest and best ever held. The new Pure Food Building is well under way. This structure will have 26,900 ft. of exhibit space and will cost $150,000. It is being erected on the unit plan and already plans are being laid to build an addition to be ready for the 1923 exhibition. Representatives of the machinery manufacturers met in Toronto recently and discussed plans for a new Machinery Hall. A site has been selected for this building, which, like the Pure Food Building, will be erected on the unit system, the first unit to provide approximately 80,000 ft. of exhibit space at an estimated cost of $300,000 to construct.

The Hudson's Bay Company is planning a $50,000 housing development at Edmonton, this expenditure to cover the construction of two bungalows and eight six or seven room houses. Messrs. Brown & Hargrave are the general contractors for these houses, which will be erected on First St., close to Portage Ave.

The board arbitrating the building laborers' dispute at Ottawa recently brought in an award of 45 cents an hour for the coming year, a reduction of 5 cents from last year's wage rate. It is expected that unions will accept this award.

The council of Waterloo County, at a recent meeting, discussed at considerable length the question of adopting the county roads system in place of the present township systems of road supervision, it being finally decided to follow the lead of several other Ontario counties who now plan their road construction programme on this basis and have gotten better results through it. Engineer Irwin, of the Ontario Department of Highways, was present at the meeting and explained the advantages of the county plan of administration by a central body. He emphatically declared that maintenance costs can be cut down 40 per cent, by this system of supervision.

Present indications are that it will not be long before a start will be made on the Gerrard St. bridge over the Don river, at Toronto. Plans for the structure have been approved by the Dominion Department of Public Works and now await the approval of the Governor-inCouncil, the final formality before tenders may be called. The structure, which will replace the present small steel bridge, will cost about $750,000, it is estimated.

The town of Weston, Ont., will submit to the ratepayers a by-law authorizing the raising of $115,000 for a high school.

His Excellency Governor-General Lord Byng recently officiated at the turning of the first sod for the foundation of the new main building of the Western University, at London, Ont. The University owns 250 acres at this site and a ground plan to take care of the probable development for the next 50 years will be worked out. The new main building will be of collegiate Gothic architecture, in grey stone, and future buildings will be treated in the same manner.

The carpenters' union at Toronto reports the present situation with regards to carpenter labor as favorable. The men are receiving the 90-cent rate of wages paid last year and it is anticipated that by the first of May there need not be a single unemployed carpenter in the city.

A two-day meeting of the policy committee of the Council of the Engineering Institute of Canada was held recently at Montreal, at which were present members from Halifax to Vancouver, the only absentee being the Victoria representative. During these sessions the committee considered and fully discussed all matters of policy regarding the general interests of the Institute, as well as of members individually, and they also reviewed it in the light of the advances made in the last two years in the matter of membership and general strength. The sessions were presided over by J. B. Challies, of Ottawa.

Personal

Mr. Gabriel Henry, C. E., Chief Engineer of the Department of Roads, Province of Quebec, has been appointed Superintendent of Provincial Roads and Highways. Mr. Henry will look after the maintenance, repairing and construction of roads in the Province.

Mr. Robert Findlay, architect, has been appointed to prepare plans for the proposed new city hall at Westmount, P. Q. As soon as the plans are completed, the public are to be invited to a special meeting to approve of them.

Mr. P. H. Mitchell, of the consulting engineering firm of C. H. & P. H. Mitchell, of Toronto, has been appointed by Premier Drury to make an inventory of the materials and supplies used on the Chippawa power development.

Mr. R. O. Sweezey, consulting engineer of Montreal, is a member of the newly organized financial concern of Newman, Sweezey & Company, of that city. Mr. Sweezey will continue to devote considerable of his time to the practice of his consulting engineering profession.

Obituary

Mr. E. T. Lucey, contractor of Yorkton, Sask., died recently. Deceased was born at Heming, Man., and had resided in Yorkton since 1918. He built several bridges in the province of Saskatchewan.

Trade Incorporation

Transcontinental Construction Company, Limited, with head office at Vancouver, capital $100,000, to carry on the business of general contractors.

Canadian Durabla, Limited, with head office at Montreal, capital $50,000, to maufacture and deal in steam, water and power engineering supplies and auxiliaries.

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New Developments in Rock Tunneling

Within recent years new conditions have developed in the West that have brought about a readjustment of hard rock tunneling methods. Engineering News Record in commenting on this subject states that for the most part these changes have not been along the line of refining and perfecting old methods, the outstanding factors, rather, being the more positive calls for speed arising from the economic demands of hydro-electric service, the advent of the mucking machine and the increase in size of tunnel heading sections. The demand for speed is doubtless the most important of these. While in some cases favoring speed over cost is fully justified, there is a fair chance through the use of modern methods and equipment that speed, the all important consideration, can be greatly increased without excessive cost. With both cost and speed thus involved by new conditions, the whole subject of hard rock tunneling methods comes up for readjustment. Further comments from our contemporary in this connection follow.

The demand for speed is especially great in hydro-electric practice because tunnels are often the limiting factor in the time required to get new power projects into service. The need for water power has become more urgent in the West and rapidly growing communities and industries have created a power demand that brooks no delay. Agricultural development of the San Joaquin Valley in California, for example, was being held back because power for pumping irrigation water was not available. The Kerckhoff tunnel for this purpose was the limiting factor in getting water on the land and the result was remarkable speed in driving that tunnel. A bonus was offered for all shots that pulled over 16 ft. and during the last ten days of the work a larger bonus was offered for the best record in an 8-hour shift. These inducements produced results; rounds over 20 ft. deep were pulled and the work was completed quickly enough to attain certain highly important objectives. Even so, the total costs on this tunnel were no more than on other tunnels of the same size and driven under the same conditions but without the means used here to speed up the work.

Not all engineers will agree with this method of offering bonuses. It is pointed out, for example, that a bonus for special shots, or even for the best shift record, is apt (1) to breed carelessness in the amount of powder used, (2) to cause overbreakage, and (3) to encourage the endeavor to make a spectacular shot at the expense of progress on the following shift. The substitute suggested is a bonus for the highest monthly average or any plan that would encourage teamwork among the three shifts.

In the last year or two mucking tunnels by power shovel has gained popularity so rapidly that it is now standard on tunnels 17 ft. square or larger. Even steam shovels with cut-down booms and dipper sticks cannot be used to advantage in tunnels of less than 17 x 17-ft. section, and if the section required approaches this size it is not infrequently increased for the express purpose of permitting the use of power shovels. The moving of the larger yardage thus entailed is justified by the lower cost per yard. While this practice of making the tunnel larger than necessary works out very nicely in hard rock, it would unduly increase the cost if applied in formation that required timbering. The situation therefore suggests the need of something in between the present mucking machine and the steam shovel. Various types of mucking machines in common use are advantageous for tunnel sections up to about 12 ft. square. Beyond that and until the section becomes large enough for two machines or for steam shovels, there is a gap in which mechanical mucking is not now being applied to good advantage. In fact, in this range of 12 to 17 ft. hand mucking has occasionally been used as the most expeditious means available.

The mucking machines used in Western power-tunnel work are the same as those built for the mining field, where large tunnels are not common; in other words, the civil engineer is using equipment developed to suit the requirements of the mining engineer. In view of the amount of large power-tunnel work to be done within the next few years, attention to this need should be a profitable venture.

With good teamwork, now less common than formerly, crews are able to work to best advantage on short rounds, but with inefficient labor longer shots are more economical. Standard practice in Europe has been toward much shorter rounds than are used in this country. In the Loetschberg tunnel, for example, the practice was to use 4-ft. rounds. This is in striking contrast to the 20-ft. rounds in the Kerckhoff tunnel. Although the Kerckhoff job probably represents an extreme, yet the tendency is unmistakably toward long rounds. In the South Fork heading, the hardest rock on the Hetch Hetchy tunnels, where the tunnel width is slightly over 13 ft., the average pull is 12 ft. or a little more. As tunnel sizes increase, deeper holes can be drilled without making the central angle of the V-cut too short for the best powder effect. The large-size power tunnels now being built or projected are introducing new problems in drill design and the manufacture of drill steel.

With the present high mucking costs (whether by hand or machine) it is more important than ever to place and load holes so that the muck will be well broken up but at the same time piled close to the heading, where it can be handled economically. On this score a well known Western tunnel builder recently said, "It is a great mistake to fill drill holes with powder; the most economical basis is to load them for six-tenths of their depth. If the character of the rock is such that a hole of a certain depth cannot break it when six-tenths full of powder, the depth of the holes should be decreased until they can be so pulled."

Until recently rock tunneling was mainly a railroad operation and like most railroad engineering it tended to become over standardized. New requirements and new thought came with the big water tunnels and they are beginning to reflect on practice.

What Will A Highway Cost?

A Reliable Method of Determining Future Costs—System Sufficiently Accurate and not Tedious

By G. F. S. MANN
In "The Highway Magazine"

Estimating has been described as an art, but it may be reduced to a science. Prices of labor and material vary from time to time, as do freight rates. This makes the keeping of costs of work utterly worthless as an accurate basis for estimating the cost of new work unless an exact record is also kept of the amount of material that is required to make up a unit of the finished work, and also of the number of man-hours that are required to construct the above mentioned unit of finished work.

Unit Price and Labor Cost

The quantity of material that is required to build a unit of construction does not vary from year to year, nor does the amount of work that one man performs in a unit of time vary greatly from one year to another. Therefore, it is only necessary to multiply the required quantity of material by the current material unit price to obtain the cost of material required at any time, and similarly it is only necessary to multiply the required number of man-hours by the current labor rate to get the labor cost at any time. By labor is meant all classes of human work from the superintendent of a job down to the unskilled labor.

The cost of machinery can, and ought to be distributed to that branch of the work on which the machine is actually used. Let a steam roller be considered for an example. In one hour, at a fixed speed, a roller will travel a certain number of lineal feet. Depending on the nature of the soil or stone that is being compacted, which determines the number of times it is necessary to pass over it, and depending on the width of the roller, it is possible to calculate the number of square yards of surface that can be compacted in one hour with a given weight of roller. This number of square yards will be very nearly constant for a given kind of soil or stone with a given weight of roller, and will not vary from time to time.

To find the cost of rolling one square yard at any time from the above data it is only necessary to find the present price of a roller of the given weight. The life of the roller may be considered as ten years (or any other figure the contractor may decide upon). Taking ten years, with twenty-five working days a month, and supposing the work is being done in a climate in which the roller may be used for twelve months in the year, then the roller has a working life of three thousand days, or at eight hours a day twenty-four thousand working hours.

The Cost of a Square Yard

To find the cost of running the roller for one hour, it is only necessary to divide the price of the roller by twenty-four thousand, and, to the result so obtained, add the price of fuel and lubricants for one hour, the man's wages for an hour, one twenty-four thousandth of the compound interest on the original investment for ten years at the current rate, and also such a sum per hour that at the end of ten years this sum with its interest will accumulate to the price of a new roller. (This last sum is charged to overhead and forms the largest part of overhead expenses.) Repairs must also be distributed to a "so much per hour" basis and added to all the above items.

If this total cost per hour is now divided by the number of square yards that can be compacted in an hour, the result will be the cost of compacting one square yard of surface.

The above method applies not only to the steam roller, but to every truck, grader, tractor, concrete mixer, etc., and even to every small tool that goes to make up the contractor's equipment.

Worth the Work

There will be many contractors to whom this method will sound tedious and quite unnecessary, but it is the only certain way in which reliable estimates may be made. The compiling of the above data costs some money, but when the observations of the work done in one hour by either man or machine, and the quantities of material which are required to construct a unit of finished work, have once been accurately determined and properly recorded it is a simple matter to make accurate estimates at any future date.

Accuracy of estimating, although the primary object of such a method, is not the only reward which the contractor will derive, for while making these time studies for the purpose of estimating, new and more efficient methods of distributing and handling men and materials will present themselves which will enable savings to be made many times greater than the sum expended in making the accurate time study and estimate.

New Publications

"Results on Road Jobs" is the title of a new bulletin issued by the Barber-Greene Co., Aurora, Ill. It is replete with practical data obtained from an analysis of road building jobs on which B-G mechanical equipment has increased flexibility and decreased costs.

The third annual report of the Ontario Fire Prevention League, Inc., has recently been published. It includes a verbatim report of the proceedings of the last annual meeting, which was held on October 18, 1921.

The Installation of Lightning Rods

The Ontario Government's New Regulations Governing the Protection of Buildings From the Effects of Lightning—Rules for the Proper Installation of Arresters

On January 1 of this year, there became effective in Ontario the "Lightning Rod Act" which aims to regulate the sales and installation of lightning arresters in such a way as to ensure adequate protection for buildings equipped with such devices and prevent the marketing of unsatisfactory rods. In response to several enquiries from contractors operating largely in rural localities, where lightning rodding is more or less general, the following resume of the Ontario government's rules and regulations is given.

In brief, the act requires that manufacturers and others selling lightning rods shall be licensed through the provincial fire marshal's office, the fire marshal being first required to approve of the apparatus and the manner of its installation. The manufacturer or agent must also guarantee the appliances and their installation, returning the cost of rodding to any owner of a building that suffers loss by fire.

A summary of the rules for installation follows:

Conductors

The material to be used for the protection of buildings and structures from lightning shall be pure soft drawn copper of not less than 98 per cent. conductivity, in the form of a flexible cable of either flat or round construction of the rope lay, stranded, loose twist, or braided types.

On buildings and structures less than 60 feet in height the cable shall weigh not less than three ounces per linear foot, or 187.5 lbs. per thousand feet in length. and shall consist of not less than seven wires in which the area of the core (if any) is not greater than one seventh of the cross sectional area of the copper. The core wire or wires shall not be of greater diameter than the surface wires of the cable. Individual wires of the cable must be not less than No. 17 B. & S. gauge in size or 0.045 inch in diameter.

When used on buildings and structures exceeding 60 feet in height, the cable must weigh not less than four ounces per linear foot. Individual wires of the cable must be not less than No. 16 B. & S. gauge; Or, double the number of cables (aerial terminals, and earth connections) shall be used as herein specified for buildings less than 60 feet in height.

The conductor—the part of an equipment connecting the air terminals with the ground terminals—must be coursed over roofs so as to interconnect all air terminals in a manner that offers the most direct path practicable from air terminals to ground, and must have either a horizontal or downward course throughout its length. When obstructions such as cupolas, ventilators, etc., are encountered the conductor should extend around and not over them. Abrupt, short bends must be avoided and no bend should have a radius smaller than eight inches.

Down conductors should be run in such a way that a stroke on any air terminal will have at least two paths from the foot of the terminal to earth. One path from a terminal to earth has been found to be unsafe, and more than two are preferable.

In the assembly of conductors, there should be as few joints as possible. All joints and connections must be made by wrapping or splicing the ends in a standard manner or with suitable devices approved for this purpose so as to ensure good electrical connection, as well as the permanency and efficiency of the system. Clamp joints, where the cable is held by one small screw, allowing the cable to be easily pulled out, are not permissible. Clamp joints made by inserting the end of the cable into a malleable copper casting and pounding or pinching the casting uutil it grips the cable are not permitted.

All conductors must be securely fastened to the sides and roofs of buildings by means of standard fasteners of the design best suited for the type of conductor used and the nature of the structure equipped. Fasteners must not be spaced more than six feet apart.

Connection of Roof Metals with Conductors

All roof metals, such as finals, ridging, rain-water and ventilating pipes, metal cowls, lead flashing, gutters, church bells, turret clocks, etc., must be connected to the conductors not as a substitute for a portion of the rods but as an addition to them. On houses, for example, the valleys should be connected to the cable nearest their upper ends.

The valleys should be connected to gutters by soldering or other good electrical connection, gutters to down spouts, and down spouts properly grounded. Extended metal porch roofs should be connected to the nearest rod at one end and grounded at the other end.

On barns, where rods cross metallic gutters, the rods and gutters should be electrically connected, and the down spouts grounded.

For the protection of life as well as property it is regarded as safest to electrically inter-connect and ground all metallic objects within buildings. Piping, and other extended pieces of metal within buildings which run parallel to a conductor for a considerable distance, say from 8 to 10 feet, should be connected to the conductor at one end, usually the upper, and grounded at the other, even though there is a thick wall between the conductor and the parallel metal piping or object. Examples of such metallic masses are soil pipes, water tanks in attics, iron tracks in hay mows, the pump rods of wind-mills on barns, the rods extending inside and to the lower floors, stationary engines, machinery or other large masses of metal.

All other large stationary masses of metal and machinery in the building including horse and cattle stalls should be directly connected to proper groundings; they may, however, be left disconnected from the conductors, providing the distance between the conductor and the object is 8 feet or more. This limit of distance applies only to buildings not extraordinarily liable to fires and explosions from small sparks, such as may be the case in oil tanks and powder magazines.

Conductors must not be insulated from the buildings.

Conductors must never be run through metal pipes.

Conductors should be placed on the sides of the buildings(usually east and west) which are most exposed to rain.

Couplings and Connectors

All couplings and connectors must be of copper or approved copper alloy.

Couplings for connecting sections of cable may be either cast or sheet copper, at least 17 B. & S. gauge .045 inch thick, of semi-tubular form, having projections in the grooves which become imbedded between the cable strands when the connectors are crimped around the cables in the form of tubes, or perforations made in the couplings through which copper or copper clad nails must be driven. The connectors must be secured to the conductor in a workmanlike manner so as to provide good electrical connections.

Connectors for use with cables for connecting branch conductors to be constructed as specified in sub-station "b," hereof, except that their form will be that of **T or Y** connectors.

Connectors for use in assembling air terminals to conductors to be of the general construction required for cable connectors, and in addition each connector is to be provided with a dowel, either solid or in the form of tube, that will fit into a terminal tube. If solid, the dowel must be provided with annular grooves, into which the tube can be crimped.

Fasteners and supports for the cable must be of copper, or copper alloy, of strong, substantial construction of at least 20 B. & S. gauge .032 inch thick.

Fasteners requiring nails, screws, or bolts for attachment to the building must be fastened with those made of copper, copper alloy, or brass.

Cast supports should preferably be of the fork design, attached to a screw or shank for mounting. The fork to be of such size and construction as to be capable of being crimped over the conductor and holding it firmly and securely in place without weakening of the prongs.

Air Terminals

Air terminals—the pointed elevations extending from the conductor into the air—must be of pure copper, of not less than 98 per cent. conductivity, made from tubing not less than 20 B. & S. gauge, .032 inch thick, ⅝ inch in diameter, or of solid copper of equal diameter and conductivity terminating in a point or number of points on one end and the other end having a screw cap, or other device, for assembling on a rod coupling, provided with set-screw or other suitable fastening or a dowel of sufficient size to snugly fit into a tube terminal rod, soldered and pinned or so constructed as to ensure permanency of connection.

The combined length of the rod and point must be within the range of 12 to 72 inches.

An air terminal is required on, or within two feet of each chimney, gable, spire, ventilator, cupola, etc. Additional air terminals are required along roof ridges and parapets, spaced not more than 25 feet apart.

On flat roofed buildings exceeding 60 feet in height aerial terminals should be placed at the intersections of lines drawn at right angles to each other and laying off squares of 25 feet on a side.

Terminals on Chimneys

Chimneys or smokestacks, exceeding sixty feet in height, which are built of material other than metal, must have aerial terminals, not less than ¾ inch in diameter, placed about the rim or periphery at intervals not exceeding six feet apart, properly connected with a heavy copper conductor in the form of a ring or band connecting all the terminals together.

The terminals must be protected from the corrosive effects of the smoke by a covering of lead at least one-sixteenth of an inch thick. The points should be bent slightly inwards to bring them directly over the opening of the smokestack, so as to divert the discharge from the smoke column to themselves. The points and air terminal rods should measure about 5 feet, or such height as will give protection to the chimney.

Instead of the above, an arch of lead-covered copper, provided with points, may be erected from the rim band, across the mouth of the chimney or an aerial terminal may be formed by placing a hemispherical or conical-shaped cage of lead-covered copper over the entire top of the stack, provided with points, properly connected to the ground rods.

Air Terminal Rods

Air terminal rods, on buildings or structures less than 60 feet in height, may be of pure soft drawn copper tubing of not less than 98 per cent. conductivity having an outside diameter of not less than ⅝ inch and wall thickness of not less than 0.032 inch. or No. 20 B. & S. gauge, for mounting the solid points on; or they may be of solid soft drawn copper, not less than ⅝ inch in diameter, provided they comply with the requirements for conductors, as herein set forth, and must be drawn to a point. Air terminal rods on structures exceeding 60 feet in height must be of pure soft drawn copper not less than ¾ inch in diameter.

Air terminal supports must be of copper or approved copper alloy, or of galvanized iron with the feet galvanized by the hot dip process.

All terminal supports of the tripod type must not exceed 40 inches in height; and if over 18 inches in height must provide at least two guides for the air terminals.

Ground Terminals

Ground terminals are the devices by means of which electrical contact is made between the lightning conductor equipment and the earth and are intended to provide a low resistance path from the air terminals to the earth. As the efficiency of a lightning conductor equipment is primarily dependent upon the thoroughness with which it is brought into contact with permanently moist earth, the base of each conductor is required to be grounded in a standard manner:

(a) By extending the base of the rod down into permanently moist earth.

(b) By connecting the conductor to underground metallic water piping at a point outside of the building

(c) Where sufficient depth of earth and requisite moisture cannot be obtained, by connecting the conductor to ground plates or other standard grounding devices sufficiently deep to provide ample capacity through a system of low resistance conductors for the distribution of the electrical charge.

How Groundings Are to be Made

Groundings made as described in "a" and "c" should extend into the earth at least 10 feet. Where the nature of the soil is such that this cannot be done, a trench must be dug from the building to a point where the required depth can be obtained, or it will be satisfactory to dig the trench at least 8 feet long where the soil is from 4 feet to 5 feet deep; and at least 12 feet long where the soil is only 2 feet to 3 feet deep, and lay the conductor in it as straight as possible. Over the cable place some fine earth and pack it down, lay large flat stones horizontally on top of this the full length of the trench, and then fill the balance of the trench with earth. The stones will prevent capillary rise of water, thus keeping the earth around the ground connection as moist as possible.

The direction of the trench should be away from, rather than parallel to, the building foundation.

Method "b" is recommended, in addition to method "a" in all cases where possible. Connections should be made by soldering the rod into a brass plug and tightly screwing the plug into the pipe, or by sweating the conductor into a lug attached to a standard clamp and firmly bolting the clamp to the pipe after the rust and scale have been removed.

In boring the hole in the earth in which the rod is to be inserted, an ordinary soil augur or a grounding rod may be used. The hole surrounding the earth connection should be tamped with dry clay, or filled with earth mixed with water to the consistency of a thick mud. The reason for this is—that if the hole is larger than the rod the resistance will be very high, and this high resistance will be retained until the earth has had time to settle around the rod, which may be several months.

Construction of Ground Terminals

Pure soft drawn copper shall be used for ground terminals; and shall consist of heavy tubes, plates, solid rods ¾ inch in diameter, or standard lightning rod, but shall in no case weigh less than 3 ounces to the foot. When separate rods, tubes, plates, or other approved devices are used the lightning rod shall be bonded or soldered to such groundings in a strong and permanent manner.

Where bed rock is at a distance from the surface of the earth, the stratum of permanent moisture is most likely to be above it, and under such conditions connection to permanent moisture is comparatively an easy matter.

When bedrock is very near the surface of the earth, the making of an adequate connection to earth is more difficult. Careful search may, however, find a depression in the rock where soil is much deeper; or a crevice may be found which will admit putting the cable down to moisture, or continuing it to low ground near a stream. Granite or other non-porous varieties of rock may offer many thousands of ohms resistance to an earth connection.

Under these conditions dig a trench where each connection is to be, making it as deep as the rock layer will allow, and bury in it a copper plate (or its equivalent of copper cable) with a surface area adequate to the extent of the lightning rod system installed.

The copper plate must not be less than three square feet in area and not less than one-eighth inch thick, and rectangular in shape, and surrounded, to a depth of about two feet above and below, with pulverized carbon or charcoal.

The use of cinders or coke is not permissible, owing to the chemical or electrolytic effect on copper.

The conductor must be firmly attached, by riveting and soldering, to the ground plate, so as to make a permanently good mechanical and electrical joint.

As an alternative system, where bedrock is very near the surface, one or more strips of the copper cable may be laid continuous around the building and properly connected at the various points with the conductors. From the strip encircling the building radial strips may also be laid if the importance of the structure is sufficient to make it desirable.

The total area of the copper strips or conductors shall not be less than 18 square feet; and such area should be increased in proportion to the size and importance of the building that is to be protected—the larger the better.

Connections between the rods and the strips should be soldered.

If there is a water-pipe system in the immediate vicinity of the rods, a connection should be made to it if possible, whether rods or metal strips are used, as this is a valuable addition to tht ground terminal.

Connection with gas pipes must, if possible, be avoided, because of the possibility of fires or explosions. On the other hand, if gas pipes are so located that it is not possible to keep at a distance of twelve feet from them, they should be electrically connected to the rod at several points, connected to earth within the building, and also well bonded around the gas meter.

Ground connections should be kept at least 12 feet from gas mains, and gasoline tanks.

The permanency of earth connections may be impaired by corrosion caused by contact with seepage from barnyards and dumping places. The contact of earth terminals with such seepage should be guarded against by drainage or other means. Corrosion may be prevented by surrounding the rod from a point 6 to 12 inches above the surface to a depth of three or four feet below the ground level, with a cylinder of dense concrete 6 or 8 inches in diameter.

Number of Ground Terminals

The number of ground terminals required is dependent upon the number of air terminals. When the required number of air terminals does not exceed six, two ground terminals will generally be sufficient. They should usually be located at corners that are diagonally opposite unless conditions are such that it is desirable to place them elsewhere.

Three ground terminals must be provided where the required number of air terminals is more than six but not more than twelve. An additional ground terminal must be provided for every five air terminals required above the first twelve.

The design of a building will, however, frequently require the use of more ground terminals than the minimum number here specified.

Groundings in addition to the first two should be spaced symmetrically about the building, giving preference to locations where the soil is most likely to be permanently moist but avoiding locations where the conductors might be subject to manure action, mechanical injury, or where they might be unsightly or hazardous.

Avoid dead ends, exceeding 16 feet, on horizontal runs of conductors, as the system should be in circuit. Additional ground terminals should be provided, if necessary, so that ground connection is provided on each side of every air terminal.

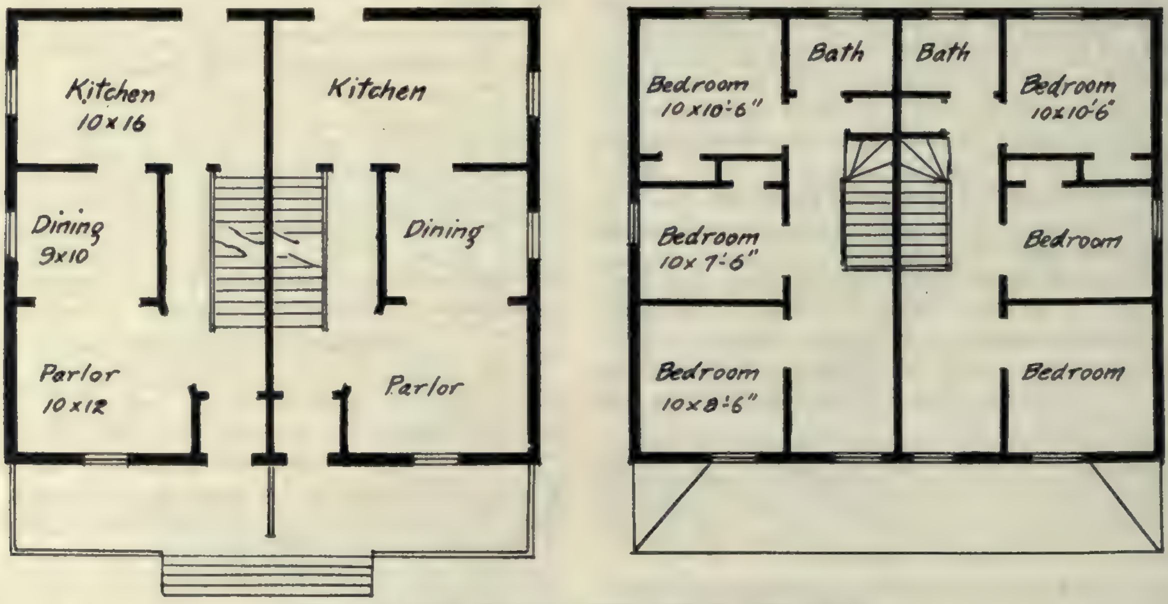
Drummondville Growing Industrially

This Quebec Town Is Attracting a Number of Large Manufacturing Concerns Because of its Numerous Advantages—Housing Question Not a Perplexing One

By **HAROLD B. FISK**

Manager, Walsh Plate & Structural Works, Drummondville, P.Q.

From an industrial point of view, the town of Drummondville, P. Q. about 66 miles from Montreal on the main line to Halifax of the Canadian National Railway, was for many years subject to many vicissitudes. The genial post master and registrar, Charles Millar, who is the third generation in direct succession to hold the position, tells us some interesting anecdotes of the the early days of the town, or as it was then, "Hamlet" of Drummondville.



Plans of a typical workman's double house in Drummondville

Founded over 100 years ago, the town has always seemed on the verge of coming forward as one of the industrial centres of the province of Quebec. One of the earlier industries was the manufacture of shuttles. Then came the bark industry. Later on iron forges were established and flourished for many years, being operated by the McDougall Company. In connection with this industry it is interesting to note that the farmers brought in the iron ore for smelting, and quantities of the ore were piled up and left as being too low grade; but during the Great War these piles of iron ore were considered sufficiently valuable to load into box cars and ship out to be smelted in modern smelters at other points. One or two boot and shoe factories were started, but after a life of more or less (mostly less) activity, each failed. The same applies to the old "Drummond Shirt."

In 1915 another boom came to the town, when the Aetna Explosive Company, Inc., decided to place their Canadian plant at Drummondville. This involved an outlay of several millions of dollars on construction and the employment of about 3,000 hands. This continued until the Armistice, and in 1919 the plant was sold to the St. Johns Dry Dock and Shipbuilding Co., who have since sold most of the equipment and buildings as scrap.

In 1914 the Southern Canada Power Company acquired the water rights and the old "Watts Estate," and from this time dates the definite industrial growth of the town of Drummondville. The power company installed a modern power station which was available for service in 1919, and at this time the Butterfly Hosiery Company Ltd., the Canadian plant of the Chipman-Holton Knitting Mills of Easton, Pa., and the Canadian W. H. Gossard Company, the Canadian plant of the Gossard Corset Company of Chicago, erected modern mills to take advantage of the facilities offered by the town, through the efforts of the local Chamber of Commerce.

In 1919 during the mayoralty of J. C. Montplaiser, the Jenckes Spinning Company of Pawtuckett, decided to commence the erection of a million dollar mill at Drummondville, and then the town was faced, as was practically every other municipality in Canada at that time, with a shortage of houses to take care of the anticipated influx of workers for the new industries being attracted to the town.

The Quebec Housing Act was then upon the provincial statute book, and the town endeavoured to utilize this Act to overcome the dearth of residences. It was found, however, that the limitations of the act prevented the workman availing himself of it, due to the then abnormally high cost of building materials. An attempt was next made to form a "housing company" to take care of the construction of the houses, and selling of them; but this idea was so slow in evolution, although the company was ultimately formed, that the town council decided that action along other lines was imperative if the local housing situation was to be taken care of.

Mayor Montplaiser had now been replaced by the present Mayor, Napoleon Garceau, K.C., but Mr. Montplaiser was appointed chairman of the industrial committee of the Chamber of Commerce, and thus co-operated with Mayor Garceau in carrying out plans, already formed, to get some houses built. Putting the situation clearly before the provincial authorities, they, under the new Housing Act, undertook to advance the town $200,000.00 for the erection of tenements, and work of construction was immediately put in hand. Tenders were called for and the construction of thirty double tenements let to several local contractors. The money advanced by the province was later augmented by a further advance of $100,000.00

The houses vary in size and appearance. Some have three bedrooms, some four. All the houses have modern conveniences, such as bath rooms, good cellars and electric wiring, which includes a circuit to take care of electric cooking. The houses rent at from $20.00 to $25.00 per month, according to size with the option of purchase by the tenant at a rate per month in conformity with the Quebec Housing Act. The cost of these residences was approximately $7,500.00 per pair, this figure including the necessary sewers and sidewalks.

Generally speaking the handling of the situation as it appeared in 1919-20 has the net result that the town of Drummondville built these houses when prices of material and labour were at the peak. These houses could probably be constructed to-day for approximately 33⅓% less, so that there is a definite monetary loss, inasmuch as no tenant would consider paying for his residence the actual cost, except in some instances, where the tenant, owing to the very easy terms under the Act, would think it worth while to own his residence, even at an enhanced cost to him, spread over a number of years.

At the same time there is a definite gain to the town by reason of the fact that even to-day when municipalities all around are crying for help to solve their housing problems, the town of Drummondville can truthfully state to any prospective industry, "The housing question in our town need cause you no anxiety. We have taken care of it." Even in this year of depression the town of Drummondville, with its good power supply, clean and attractive appearance, houses to rent at reasonable rates, is able to attract new industries, and only a short time ago the National Silk Dying Co., a $20,000,000.00 corporation of Patterson, N. J., bought 13 acres of land and are going right ahead with the construction of their Canadian plant, because, as the president of that company stated, "conditions in Drummondville appear more normal than in any other suggested location I have visited, so we will go right ahead."

Brick on Edge Form an "Ideal Wall"

The Term "Ideal" Is Applied to a New Type of Construction Which Saves Materials and Labor and Produces the Advantages of Hollow Walls

The term "Ideal" has been used recently to describe a new type of wall advocated by manufacturers of brick. This type of construction consists in laying the brick on edge, bonding the two faces together by headers. In the 8-inch type of this wall, every other brick is a header. The manufacturers claim that the Ideal Wall has the advantage of a considerable saving in both materials and labor, and at the same time produces a dry wall, combining the advantages of solid brick and hollow unit wall construction with a lower cost than either solid brick or tile walls.

Insulation Against Moisture and Heat

In this type of construction there is an obsolute and positive break in the mortar joint in the direction of the thickness of the wall, thus accomplishing with ordinary brick what has been sought for with unit block construction. The brick themselves will not carry water through their entire length. It is possible that a mortar joint might do this under certain circumstances, but with this new type of wall that danger is entirely eliminated. It is claimed that the hollow space formed by this type of construction affords protection against extremes of heat and cold, insuring a cool house in summer and a warm house in winter. The advocates claim that it is entirely satisfactory to plaster directly upon the brick without furring, although many architects insist that furring on outside walls should always be used.

The exterior appearance of a house built with Ideal wall is pleasing, the mottled appearance of the brick alternating with the rough face of the brick and its smooth end is highly pleasing, and the color may be chosen to suit the occupant's taste by selecting the type of brick to be used. In some cases special face brick are used for the outside walls, while ordinary common brick are used for the inner face. Light-colored brick may be used for the headers and dark wire-cut or tapestry brick may be used for the stretchers which, of course, are laid on edge thus utilizing the full value of the face.

Details for this type of wall have been developed by the Common Brick Manufacturers' Association and are well presented in their bulletin entitled, "Brick, How to Build and Estimate." Details for laying up corners, for setting joists and lintels, etc., are given, together with numerous tables of quantities of materials required.

Lime Mortar Satisfactory in Ideal Wall

Either lime or lime cement mortar is suitable for use in this type of construction. It is essential that the mortar be smooth and easy working so that the mason can handle a full trowel and butter the edges and ends of his brick easily. If the mortar is short-working it will not cling to the brick nor stay on the trowel, which, of course, will slow down production decidedly. Although bricklayers are not as yet entirely familiar with this type of construction, it has been found that it is very easy to get the knack of laying the brick on edge and that it is decidedly easier to lay a greater area of wall per day. It has been found, however, that bricklayers will closely approach the number of brick laid in solid walls when using this new type of construction, which goes to show that there is a decided saving for all concerned inasmuch as a much greater area of wall is erected in the same length of time.

Tests have been conducted as to the fire resistance and strength of this type of wall by private laboratories as well as by the Government, and in every case have shown it to be entirely satisfactory. It is at present admitted by many building codes and its use is rapidly increasing.

Brick in 8-Inch Ideal Wall

(From "Brick, How to Build and Estimate.")

Sq. ft. area of wall	Total no. of brick	Cu. ft. of mortar
1	9.035	.080
10	90	1
20	181	1½
30	271	2½
40	361	3
50	452	4
60	542	5
70	632	5½
80	723	6½
90	813	7½
100	904	8
200	1,807	16
300	2,711	24
400	3,614	32
500	4,518	40
600	5,421	49
700	6,325	57
800	7,228	65
900	8,132	73
1,000	9,035	81
2,000	18,071	162
3,000	27,106	243
4,000	36,141	324
5,000	45,176	404
6,000	54,212	485
7,000	63,247	566
8,000	72,282	647
9,000	81,318	728
10,000	90,353	809

Common practice in estimating 8-inch solid brick walls allow 12½ to 15 brick per square foot of wall surface, depending upon the thickness of joints. Note the economy of the Ideal Wall.

A Power-Swiveling Loader

The Canadian Link-Belt Company, of Toronto and Montreal, after years in developing portable loaders, have placed on the market a machine that digs and loads all sorts of bulk material without need of labor other than the operator. The elevating medium is arranged to swivel in a horizontal plane. This feature, coupled with a self-propelling mechanism, produces a unit which actually clears a path wide enough for the loader to move into piles of material.

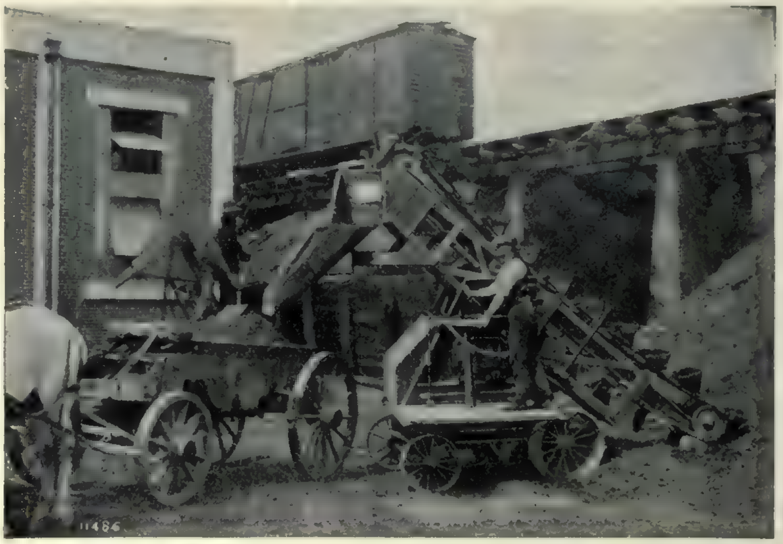
The operator directs the digging end of the elevator in an arc, the maximum width of which is over 20 feet. When cutting reaches the end of each arc, the loader is advanced a short distance automatically towards the pile, thus making a wide cut in the pile as far as required. Provision is made to prevent damage to machine in case the buckets strike a hidden obstruction.

It is not necessary to drag or scrape the material into the path of the buckets as the digging buckets are carried on chain, the whole operating on the principle of taking the buckets to the material. The hardest work required of a loader is the digging. With this in mind the buckets are provided with digging edges; the top of every other bucket is an arc, and the alternate bucket a rectangle. This feature permits of the bucket digging with a fresh surface, cutting with a portion of its edge only and eliminating the heavy drag and shock to machinery occasioned by the entire bucket surface digging into the pile.

The operator stands on a roomy platform which swivels with the elevator, permitting the operator to have the digging and discharge points in view at all times. All controls are in easy reach. The operator, being elevated above the ground and away from the moving parts, is free to center his efforts toward loading the greatest amount of material without giving thought to personal safety.

The power swiveling loader has a capacity for handling 45 cubic feet per minute of loose materials, and a speed of 65 or 75 feet per minute, forward or backward; can be collapsed to an overall height of 9 ft. 8 in. for passing obstructions, or storing in a building, and can be operated by 7½ h.p. motor, or 15 to 20 h.p. heavy duty gasoline engine. Its construction is all-steel.

A new digging and loading machine requiring no labor other than an operator. A description is contained in an accompanying article.



Surface Treatment of Gravel Roads

Experiences of Maine State Highway Commission Described in a Paper Presented at Annual Conference on Highway Engineering, Ann Arbor, Mich.

By **PAUL D. SARGENT**, Chief Engineer, Main Highway Commission

For the last eight years the Main State Highway Commission has been surface treating gravel roads with success. During that time we have used exclusively a refined tar product suitable for cold application.

Naturally, we more or less followed in our early tar applications methods in vogue at that time. We attempted to get a true crown on our gravel roads by adding an inch or an inch and one-half of new gravel where necessary and then by the use of a drag or light grader truing up the surface before the application of the bituminous material. The first year this work was done on any scale we applied our bituminous material in two applications. In May we used about 0.4 gal. to the square yard and about the first of August retreated all of these surfaces with an additional 0.2 gal. per square yard. Treatment was laid only 10 ft. wide. The real thing we sought to do with this treatment was to bond the loose surface material to the tightly bonded surface below it, and we fairly well accomplished this result.

By the end of the season, however, we observed that on certain sections of our roads so treated there was a slight rippling and waving of the surface. It occurred to us that this might be on account of the fact we had not secured an effective bond between the loose surface particles of the road and the tightly bonded gravel beneath. In other words, the material which had been impregnated with tar had laid more or less as a mat upon the surface, and not being sufficiently filled with mineral aggregate had pushed.

We had obtained, however, a much more satisfactory surface, generally speaking, than we had ever before seen on a surface treated road. The good sections presented the appearance of a first-class bituminous road surface, tightly sealed, smooth and dustless. As might have been expected, the edges of the bituminous treated sections sheered off and crumbled away on account of so much traffic turning out for meeting and passing.

Our next development was an attempt to clean the gravel surfaces before the application of the tar. This was accomplished by the use of graders and drags and later by using a street sweeper and finally by following that with hand sweeping. We also increased the width of our treatment to 15 ft. We found that all of these steps gave us a much improved surface and, in fact, since the first year we have used tar we have never made but one application to any gravel surface during a season. No sand covering was used during our first two or three years of treatment. The tar was applied on warm, dry, days from an automobile tank distributor under pressure, and we just allowed the tar to lie on the road until it was absorbed and took its set.

Needless to say, we had much complaint from the travelling public on account of the dangerous condition of a freshly tarred surface for rubber-tired traffic. We attempted to obviate this danger as far as possible by treating one side of the road at a time. We would do a considerable stretch of road, anywhere from 6 to 10 miles long, and treat it on one side only. While the treatment was being put on the first side the other half of the road was left open for traffic and by the time we had the first half finished the tar that had been first laid was well enough set so that traffic could go on it. Then the other half of the road would be treated in the same way.

We observed, of course, that steel-tired traffic wherever it ran on the freshly tarred surface stripped the bituminous material from the surface. This made it necessary to do more or less patching by hand. Also, on account of the increasing automobile traffic, which was continually getting on to the freshly tarred surface, we found it necessary to sand the tarred surface a few hours after application.

For the last three or four years we have made a practice of treating all of our surfaces 18 ft. in width, which has practically obviated any necessity of patching on the shoulders or edges of the treated surfaces. Eighteen feet in width, which, by the way, is our standard width of pavements and hard surfaces today, accords a good double track way. We have been following the practice during the last three or four years of immediately covering the bituminous material with a light application of sand. By immediately, I mean that within 5 or 10 minutes after the distributor has delivered tar to the surface of the road it has been covered with sand.

There are one or two points about sanding that I think should be spoken of. We place the sanding gang at intervals of 150 to 200 ft. apart, according to the length of road that the tank of tar will cover. Immediately the tar tank has passed, these men begin to sand and the sanding is started at the center of the road and first a place is made where passing vehicles may turn out on the freshly tarred surface. This affords traffic meeting places at stated intervals, so that with careful driving it is not necessary for a vehicle to become smeared or spattered with tar or to take the risk of skidding incident to driving on a freshly tarred surface. Our sanders are also instructed to keep an eye to the traffic so in case anyone gets into difficulty we will have some witness as to what actually happened. These men also more or less caution drivers to be careful. Where we are applying tar over a summit grade we always plan to have a sander stationed at the summit to keep an eye to passing vehicles and to warn them against collision. These are points we have learned from experience and we have found them to pay. I offer the suggestions for what they are worth.

Present Standard Practice

I might say that in general we have developed the following standard practice: As early as we can get on the roads in the spring, that is, when the roads begin to settle and dry out after the frost has left them, we begin shaping with the road grader. The roads are carefully watched during the two or three weeks while they are settling and are shaped either with a drag or blade grader several times if necessary to have them settle with as true a contour as possible. The next step in our surface treatment is to draw out sand, which is left on the shoulder of the road in piles of about ¼ yd. every 25 feet. Generally speaking, we use about 50 yd. of sand to a mile of cover. We use less sand, however, on a brand new treatment than we do on retreatment. Sometimes as little as 30 yd. to a mile is used on the original treatment. Retreatments will take from 40 to 50 yd. per mile, as the tar has less opportunity to penetrate into the surface of the road. The next step is to clean the surface of the road of all loose materials. If a pocket of sand, dust or stone is left on the surface we are absolutely sure to have the treatment break over that pocket in a short time after application. This cleaning is done by the use of a street sweeper behind a light truck and if further cleaning is necessary after the sweeper has finished, this is done by men with push-brooms. Then comes the tar-distributing gang, which is equipped with Kinney pressure distributors mounted on 3½-ton trucks. We have limited ourselves to this size of equipment because it is as heavy as our roads, generally speaking, will carry. We have a law which limits the gross weight of load to 9 tons. and I am free to say that one of these 600-gal. tanks filled with bituminous material will a little exceed the limit set up by statute for the gross weight of load. Under average conditions one tank truck will spread about 2,500 gal. of tar per day.

We still hold to the practice of tarring one side of the road at a time and several days may elapse between the tarring of the first side and the tarring of the remainder of the road. As pointed out above, immediately after the tar is applied a light sanding is given. We put on just enough sand to fairly blot the bituminous material and keep it from running off the crown of the road to the edge. The surface is carefully watched for three or four days, and if evidence of bleeding shows up spots where this occurs are treated with more sand. Sometimes after a treatment has been down for two or three weeks an extremely hot day will start a little bleeding. This is watched carefully by the patrolman and the same treatment of lightsanding given.

In the treatment of new gravel surfaces, that is, surfaces which have never received a treatment before but which may have taken traffic anywhere from two to four or five years with an occasional resurfacing of gravel, we use not to exceed ½ gal. per square yard, and in more cases probably use 0.4 to 0.45 gal. per square yard for the treatment. The amount of material depends upon the tightness of the surface. We have found that the smallest quantity of material we can use and get the surface covered gives us the best result. With a small quantity we never have trouble from rippling or waving of the surface, provided the gravel is in proper shape to receive the treatment when it is given, that is, thoroughly bonded and tight with no pockets of loose gravel, dust, or other material. We also find that surfaces which have received a small quantity of tar can be re-treated for a longer time than surfaces which have been given a heavier treatment. Those which have received the heavier treatment will ripple and get out of shape, say in two or three or four years, while sections receiving a light treatment can be maintained without breaking up for a considerably longer time.

It must be borne in mind that the addition of the bituminous surface treatment to a gravel road does nothing but preserve the surface against disintegration from passing traffic. It does not materially strengthen the road in the sense that it will cause the road to carry heavier loads than the gravel surface itself or the foundation upon which it is laid will sustain. Surface treatment will not supply or take the place of drainage.

Maintenance of Surface Treated Sections

Our surface treated sections are kept under constant patrol maintenance. We patrol these roads with a light truck and two men and they are assigned sections anywhere from 12 to 18 miles long. Besides watching the bituminous surface and mending any small breaks that may occur—and we have these breaks occasionally—and patching the shoulders, these men also keep the dirt shoulders shaped by dragging, keep the gutters and culverts clear, and do whatever other work is necessary. We supply about 3 bbl. of bituminous material like that with which the road is treated for each mile of surface. This material is mixed with sand and kept in stock piles. The mixing is usually done by hand, and we use about 17 gal. of tar to cu. yd. of sand. In a few instances we have used a small concrete mixer to prepare the tar and sand for patching and we have been able to use as little as 14 gal. to a yard of sand when the mixing is done in a concrete mixer. Patches are made by simply cleaning out the hole, throwing in the mixture of bituminous material and sand and patting it in with a shovel. Any bad breaks on the shoulders are repaired in the same way.

Condition in Spring

The most of our gravel treated surfaces do not remain intact over the spring period, a good deal of it breaks up. This is due to several causes. An open winter which allows the frost to penetrate deeply into the roadbed and allows traffic to run all winter long, or heavy traffic coming on these surfaces when the frost is leaving and the surfaces are soft will break up and generally disintegrate the surfaces. This really is more or less of an advantage, because it obviates the necessity of breaking up these surfaces and we save just that much expense in getting the surface ready for subsequent treatments. I have in mind one section of gravel road which was surface treated during the summer of 1920. Most everyone called it a good section of road; in fact, many automobilists have referred to it as bituminous macadam and many of our citizens refer to our surface treated gravel roads as bituminous macadam roads, especially when they want to tell about a bituminous road the Highway Commission has built which has failed in the winter. The particular section I refer to was so bad during March, 1921, that automobiles could not pass over it, or through it. For 4 or 5 miles this piece of road was literally a sea of mud for a period of about three weeks. Of course the surface treatment completely disappeared. We reshaped the road as it dried out and retreated it last spring. It presented a good surface all through the summer and fall until it was covered with snow. I apprehend that the coming spring will be a repetition of the spring of 1921. The road will be in about as bad condition as it was then but by June 15 it will look like a boulevard.

On the other hand, I have in mind one section of surface treated gravel road which is built on a sandy foundation where the drainage is perfect, that has never broken up during the last 8 years. It gets a re-treatment about every other year, maybe 1/6 or 1/7 gal., as the gang goes by, and during the intervening year it does not get treated. This particular section shows evidence of slight ripples. It is on our heaviest travelled line, where the snow leaves earliest in the spring and we have the most severe truck trafic in the state.

We have a good many sections of surface treated gravel roads which do not break up in the spring. The most of these sections get a re-treatment each year. The second year the amount of tar which we have used has been from 0.3 to ⅛ of a gal. per square yard. For the third and fourth years the amount has run as light as ¼ gal., and in some instances 0.2. These surfaces are quite apt, however, after three or four re-treatments, to become ripply enough so as to be uncomfortable to ride over. This condition is due to a combination of reasons. One is that we may have as much as 1½ in. or 2 in. of tar penetration which becomes separated from the gravel road itself on account of the passage of heavy loads when the frost is coming out of the roads and the whole roadbed is more or less soft.

Treatment for Wavy Surfaces

Where this tendency exists at all it is always more pronounced where the surface has received successive treatments than where only one or two treatments have been given. Each year we have to break up more or less of this kind of surface and get the road in shape for new treatment. The method used is about as follows. We take a section of road about 1,000 ft. long; it is broken up either by using a pressure scarifier on a steam roller or by using a heavy blade grader behind a truck or a roller and setting the blade so that it will do more of a plowing operation than a scraping one. The bituminous surface is in this way broken up into chunks anywhere from 2 in. to 2 or 3 ft. square. We next take a road grader and scrape this whole surface off to the shoulder of the road, then we plane the roadbed below to as true a surface longitudinally and transversely as possible. We then work back a portion of the bituminous bound material from the shoulder, distributing it over the surface. In this distributing operation the bituminous bound gravel is broken up more or less into small chunks. We then leave the road for two or three days for traffic, which materially helps in further breaking up these pieces of bituminous bound gravel, then the road grader is brought on and further working of the surface is given just by pushing the junks around and pulling in more from the sides. By watching the surface carefully and using the road grader every two or three days we have been able to get the surface back into reasonably smooth condition. It presents more or less of a mottled or mosaic appearance.

Gravel which has been covered with the bituminous materials has lost its binding property and it is necessary quite often to add a bit of good binding material here and there to complete the bonding of the surface. This bonding material is used sparingly. We do not intend to have enough to leave any appreciable amount of dust to be swept off prior to the new treatment. As soon as we have the surface in shape we plan to immediately give it a new application of tar. We find that one of these surfaces broken up and reshaped as just described is very hard to keep in true contour under traffic, and if it is allowed to go, say two weeks, we may have to break it up and rebond it before the tar surface treatment is given, else it would be so uneven as to be a bad riding road all through the season.

Experience has shown that one of these old tar surfaces can be scarified and broken up much more easily when the temperature is between 60 and 70 deg. F. than during cooler weather. Good warm, sunny weather also materially assists in breaking up the chunks of tarred gravel which are left on the surface of the road.

One thing we have satisfied ourselves upon is the fact that we cannot successfully apply tar surface treatment on a wet road or on a damp road. We have also had the experience of rain falling within two or three hours after tar has been applied and before the tar has taken any set, and with a traffic say of 100 to 200 cars per hour this has resulted in making a mushy surface which it is practically impossible to true up and make satisfactory. We have practically come to the conclusion that when this condition prevails we would do better to scrape the new tar surface right off on the shoulder, throw it away, reshape our road and put on a new application of tar. We will spend more money in patching the surface which is laid under these conditions than it would cost to replace the surface, and such surface after patching has never been satisfactory.

Cost of Tar Application

During the last four years our surface treatment work, plus the cost of patrol maintenance, for a season of eight months, has averaged to cost $1,000 per mile. We estimate sand to cost us an average of $2.00 per cubic yard delivered in piles along the side of the road. Tar costs us $0.12 in tank cars delivered on the nearest railroad siding. We figure the cost of applying the tar at $0.02 per gallon. Sanding costs about $0.75 per cubic yard of sand. Using, say 4,000 gal. of tar per mile gives us a cost for tar on the roadbed of $560; 50 yd. of sand will cost $100, applying the same $37.50, making the cost of the tar treatment covered with sand $697.50.

The average cost of shaping and getting the surface ready for treatment in the early spring would be about $25.00 per mile. We use ordinarily a 2-ton truck to draw the road machine. The truck rental would be $10 per day, the driver's pay $3.75 and a helper $3. The rental of the road grader is figured at $2 per day. Gas and oil will run from $5 to $6 a day. This outfit will average to smooth four miles per day. Usually on the first smoothing we make about four round trips per mile. On subsequent smoothings possibly two trips will do; it all depends upon the condition of the road when it is smoothed and the subsequent condition of rain and settling of the road.

Cost of Sweeping

For sweeping we use a mechanical sweeper drawn by a light truck, say a ¾-ton or a 1-ton truck. We usually make four round trips with the sweeper, and this outfit will sweep about two miles per day, as we can only run the sweeper about three miles per hour. The expense for sweeping would run about as follows:

	Per day
Truck rental	$5.00
Oil and gas	2.00
Driver	3.75
Helper	3.00
Rental of sweeper	2.00
Total	15.75

On the basis of sweeping two miles per day this gives a cost of $7.87 per mile.

Cost of Patrol Work

The balance of the $1,000 is paid for patrolling the road through the season. The usual patrol gang in bituminous surface-treated gravel roads is a patrolman with a 1-ton truck and helper. According to the amount of traffic and the condition of the road, this outfit will cover anywhere from 12 to 18 miles of road. The outfit costs $13.75 per day, made up as follows:

Rental of one-ton truck	$5.00
Gas and oil	2.00
Patrolman, who drives the truck ..	3.75
Helper	3.00

These gangs work an average of 200 days per year, so if the patrol section was 13¾ miles long the average cost per mile would be just $200.

Based on the figures given above, this would show a maintenance cost of $930.37 per mile. I have said that on new roads we use ½ gal. of tar per square yard. That will increase the cost $140 per mile over the figures already given.

Where it is necessary to scarify or break up the old bituminous surface, we run into a considerably larger expense for preparing the surface than indicated above. I think I have given enough explanation, however, to show that the average cost is very close to $1,000 per mile.

There is one point that I neglected to mention, and that is that quite often in making an original treatment, if traffic is running fairly heavy and it will take us six or eight days to treat the section we are working upon, we will slide over the road with a priming coat of the tar material, using 0.2 to 0.25 gal. per square yard, the quantity depending upon the tightness of the surface. This will hold our surface in perfect condition under traffic for a week or ten days. We immediately apply the balance of the quantity, sand, and finish up the job. We have almost come to the conclusion that it would be good practice to do the priming everywhere on new surfaces. It gives a better penetration of the bituminous material, besides holding the surface in proper contour until the treatment can be completed.

Traffic on Surface-Treated Gravel Roads

I ought to state before closing that we have many miles of surface-treated gravel roads which are carrying a 12-hour traffic, from 7 a.m. to 7 p.m., averaging from 2,300 to 3,500 vehicles per day for a week's time, with a maximum traffic during the 12-hour period of as high as 5,500. This traffic continues for a period of four to five months, from about the 20th of May until well toward the first of October.

We find it impossible to hold our gravel surfaces in satisfactory condition by ordinary patrol maintainance methods, that is, dragging and patching with gravel, when the traffic exceeds 500 to 600 vehicles per 12-hour day, and the expense of such maintenance runs about $500 per mile.

The proceedings of the fourth annual conference of the Association of Canadian Building and Construction Industries have been published in summarized form. Copies may be obtained from the secretary, Mr. J. Clark Reilly, 44 Central Chambers, Ottawa.

The Right Equipment

How to Select Machinery for Concrete Road Construction—The Key to Profit and Loss

By H. J. KUELLING
In "The Constructor"

In discussing the above subject the writer has confined his statements quite largely to the equipment used in concrete road construction. This has been done for two reasons: First, that he feels better qualified along these lines than along others, and, second, that that type covers a larger proportion of the construction in the middle west than does any other type.

One primary object must be kept in mind by the contractor seeking equipment for a concrete road. And that is, anything which might tend to interfere with the operation of the mixer should be eliminated or reduced to a minimum. When the mixer ceases to function, the income producing end stops. Mixing means yardage, and yardage means dollars. The more days per year the mixer operates, the greater the profit in total and in percentage, because the loss in percentage becomes that old bugbear, overhead, and the loss in percentage is depreciation, interest and lost time.

This may all sound very much like kindergarten rules, but how often have we all seen a mixer idle and the revenue stopped and expense continued because of a broken water pump, when an emergency pump would have saved its cost in a short time; or have seen all operations stop because a train jumped the track because of a poor roadbed; or the cement played out because of a lack of storage; or material stopped coming because of a broken cable and no other within ten miles; or a dozen other things that can happen to a poorly-planned job or one with cheap, but in the long run expensive, equipment.

Flexibilty of Equipment Very Desirable

Another important consideration should be the flexibility of the equipment. What is good for one job or section of the country may be and often is quite unfit for operation in some other section or community. One should remember that a non-flexible equipment means a limited range of jobs. For instance, a man with an industrial equipment must realize when he is purchasing it that he is limiting himself to certain topography, certain shipping and material conditions. The man who is purchasing a local pit or quarry equipment must expect to be limited in his sphere of operations or to have a certain amount of idle equipment.

The contracting fraternity must be ever mindful of the fact that the public, who is paying the bills, expects and will eventually get its roads built with the equipment that will do it the cheapest: in other words, for the fewest dollars, that is, unless a large and expensive layout can be shown to be the cheapest in road cost, then it is not the proper equipment. If the interest and depreciation on a large outfit outweigh the additional labor cost on a smaller and simpler outfit, then the simpler outfit should be used. The writer believes that the successful construction of a large mileage of concrete roads is a series of small operations, rather than a few large ones. Putting it in another way: he would choose five outfits of $25,000.00 each rather than one of $125,000.00, as he believes he would make more profit as a contractor, would not have all his eggs in one basket, and would build more miles of road at a lower cost.

Profit Tied Up in Secondhand Equipment

Many a contractor who made a fair or good profit in the past two years has most of it invested in secondhand equipment, and he must either take a loss in its sale or continue with his same methods in competition with newer and more up-to-date equipment. Many contractors with large expensive layouts are finding this out with the keen competition present this year in highway lettings.

In a level country where the soil is a heavy clay or a light sand, making hauling conditions bad, industrial equipment will give good results if the project is a large one. It is well to bear in mind the fact that, with equipment of a size suitable to keep a 28-cubic foot paver busy, a constant supply of material must be maintained at the mixer or the average yardage will fall way below the expectations, and the item of depreciation will eat up the estimated profits.

It is true that more yardage can be laid with an eight-sack paver than with a four-sack paver when materials are available and every unit in the long chain functions properly, but it will be noted that many of the published records are for a few days run and not the operation of an entire season. Averages maintained by four-sack pavers that have come to the writer's attention have, in most cases, been higher in proportion than those of the larger outfits. Not only have they been larger, but more uniform and more constant, therefore, more profitable.

The advantages derived from the use of industrial equipment lie in the fact that the subgrade is not disturbed. The hauling can be done at any time that the sub-grade is dry enough to receive concrete. Given a good track, easy grades, and ample power, heavy loads can be hauled at high speed. On loose sand or some heavy clays, where trucks or teams would be seriously handicapped, industrial equipment will furnish the most economical transportation.

The disadvantages are that high first cost means high depreciation. The installation cost is all out of proportion to the small amount of material handled per mile of country road. It cannot be used economically in rough country. It cannot be used for other work when not in use on the road, as can trucks and teams.

Central Mixing Plants

In the matter of central mixing plants, the writer's observation leads him to believe that they will never become very popular except possibly in city work. The advantages of this method are not obvious, while the disadvantages are many. Hauling water is much more expensive than piping it, especially when the pipe is necessary for curing purposes anyway. On long hauls, concrete, unless mixed to exactly the right consistency, is hard to remove from the containers. The crews do not work as conveniently as the mixer crew must start earlier and stop earlier than the finishing gang.

After many trials, several States, notably Pennsylvania and Wisconsin, have now prohibited the use of central mixing plants on highway work.

Another method of transportation that is increasing perhaps faster than any other is hauling dry batches on trucks. This method is much more flexible than the industrial track. In the first place, it does not generally require a crane to unload, as most of the trucks are self-dumping trucks, emptied directly into the hopper. This method gives a very uniform measure, especially when used with some of the newer devices, which enable a three, four or five batch truck to be loaded instantly by pulling one lever. This cuts down all lost time at the loading end.

Some of the disadvantages of this method are that the trucks are rather hard on the sub-grade, thus requiring extra labor in caring for it; they cannot operate on some days when the mixer could operate, thus tending to be disadvantageous, especially in wet weather when the sub-grade is often in condition for pouring but not for hauling. The investment is quite large, especially if the haul is of any great length. Another disadvantage is that the trucks do not hold as large a load as the large trucks which are hauling bulk material. They are, therefore, more costly in operation because every driver handles a smaller quantity per trip.

Stockpile On or Near Sub-Grade

Another method that is used in transporting materials is to stockpile on or near the sub-grade. Where the material is put in large stockpiles a considerable saving can often be effected by hauling the material before the grading is done. This gives a harder surface to haul over and it can be done without as much lost time to the paving crew. This method of hauling is the cheapest kind of truck hauling, because the larger trucks can be used.

Where the material is stockpiled or windrowed on the sub-grade, we have a more constant operation of the mixer than by any other method. As noted in the beginning of this article, this is the thing to be most sought after in the planning of a concrete road operation. Every day lost on the mixer means a corresponding loss on the job. This simpler method is less affected by the weather, because, as noted above, the sub-grade is often ready for pouring but not for hauling. However, it requires somewhat better inspection, as there is some danger of getting subgrade material into the concrete, but over a series of years this has not been found to be as bad as some of the salesmen try to make contractors believe. Considerable foreign material gets into a concrete road no matter which method of material handling is used. It may come from coal or sticks in the cars, or may come from the clamshell digging into the ground when loading from stockpiles. Careful inspection will prevent most of this, and careful preparation of the sub-grade before dumping material will save the contractors most of the theoretical loss in material. It must be admitted, however, that this method loses more material than any of the other methods. The investment is the least of all in this scheme, because the trucks, when not in use on the road, can be operated on other work. This latter scheme is difficult either with the batch boxes or with industry track.

With labor conditions fairly easy, as at present, the writer believes that the wheelbarrow and shovel method, that is, handling the material by hand, is not by any means out of date.

The writer believes that a four or five-batch paver is the most economical. This may be driven by steam or gasoline, and should have a caterpillar tread. A contractor should have double pumping facilities connecting up with at least a two-inch pipe line. He should have some mechanical strikeoff, as that is the hardest work to do on a job.

The Power Resources of the Prairies

Water Power, Coal, Oil and Gas Combine to Provide a Vigorous, Aggressive People With Ample Means for Developing Their Tremendous Natural Resources.

By Water Powers Branch, Department of the Interior, Ottawa.

Pioneers in a new country are usually at first dependent on their own muscular efforts for the power necessary for their various labors; as settlement increases and wealth accumulates it becomes possible to employ machinery driven by steam or oil engines, small towns appear supported by and supplying the wants of the inhabitants of the surrounding territory. With the passage of time and the successful development of the country, pioneer towns become cities and new towns grow up, the inhabitants of which, conscious that the pioneer stage is past, demand and obtain for themselves the amenities of civilization in the form of public utilities—water supply, drainage, electric light and power and finally street railways. These public utilities need the support of both population and industry, and industry needs power, so that the development of a new country is closely linked with its power resources.

The Prairie Provinces provide examples of all stages of civilization ranging from pioneer in the north, to the most modern in the south, and the following brief discussion of the power situation shows both how well equipped the more densely populated sections are and how great are the power resources of the whole area for future requirements.

ALBERTA

The present thickly settled portion of the province is the south-east—this is almost entirely underlain by coal, has considerable natural gas resources now in use and good prospects of oil developments—the public utilities and manufacturing industries are largely operated by fuel and it appears must continue to be. In the north-west and north the large water-powers, the natural gas and oil fields, and vast bituminous sand deposits, will provide ample power for future development.

The province possesses available water power to the extent of 475,000 h.p. for maximum commercial development. The principal developments are those on the Bow river near Calgary with 32,380 h.p. installed but the majority of the water-power is considerably north of Edmonton and is not accessible to the, at present, most densely settled portions of the province.

Coal

Alberta is by far the greatest of all the provinces of Canada in coal resources, possessing as she does 88 per cent of all the coal in Canada and 1/16th of the coal resources of the world. As respects Canada the comparison may be shown thus in millions of tons:—

Alberta	1,182,572
British Columbia	83,828
Saskatchewan	65,943
Nova Scotia	10,715

The classes of coal in Alberta are thus:—

Anthracite	1,183
Bituminous	217,593
Lignite	963,796
	1,182,572

Much of this "lignite" is of high grade, suitable for steam raising and domestic use. The anthracite is found at Bankhead and along the eastern slope of the Rocky Mountains and is also reported 200 miles northwest of Edmonton. The bituminous and lignite coals are distributed over the greater part of the province including the Peace River District.

In 1920 the output of coal in Alberta was the highest on record and constituted 41 per cent of the total Canadian output.

Oil

So far the recorded production has all been from the Turner Valley field 35 miles south of Calgary, this yielding a light oil as follows:—

	Bbls.	Value	Per Bbl.
1915	small		
1916	small		
1917	8,500	$63,302	$7.45
1918	13,040	100,004	7.70
1919	16,437	97,841	5.95
1920	11,718	75,295	6.42

Indications are, however, both numerous and promising over a wide area and active investigation is proceeding.

In the south the formations are similar to those of Montana where large producing wells have recently been located near the international boundary. Mr. Ommaney, Investigation Engineer, C.P.R., states that:—

"The oil in these two great producing Montana wells undoubtedly originated from the Devonian formations which extend throughout the whole of the vast Canadian territory to the north up to the newly proven field in the far northwest."

The latter refers to the oil strike by the Imperial Oil Co. at Fort Norman on the Mackenzie river, reported at 1,000 barrels per day. This however is far north on the Alberta boundary.

Along the Athabasca river, near Fort McMurray, 200 miles north of Edmonton, are vast deposits of bituminous sands, outcropping for some 175 miles, 150 to 225 feet thick and estimated to cover an area of 750 to 1,000 square miles with probable wide extensions under heavy cover. (Dr. S. C. Ells.) Some 72 samples have been analyzed by the Department of Mines. Seepage of gas, heavy oils and tar are found throughout this district and in addition to probable wells the bituminous sands themselves are the potential source by treatment of "an enormous source of crude oil, fuel oil and their derivable by-products." (G. G. Ommaney). Six companies are reported to be drilling in this field. The known deposits are estimated to hold some 30,000 million barrels of oil.

Near Peace River Landing oil has been found in two wells in apparently commercial quantities.

Oil Shale

Shale occurs at many points and the bituminous tar sands are largely overlaid by shale but no reports as to any extensive oil bearing shales appear to have been made.

Natural Gas

There are a number of large gas fields in active operation. The Medicine Hat field has 33 producing wells, the Bow Island field 21, the Viking field 9, and there are several other smaller fields. The total production has been:—

	M. Cu. Ft.	Value
1916	6,094,231	$1,113,296
1917	6,744,130	1,299,976
1918	6,318,389	1,358,638
1919	8,230,838	1,365,127
1920	5,633,442	1,181,345

Market for Power

The natural resources of the Province of Alberta are large and varied and the manufacturing industries show rapid growth as illustrated by the following Dominion Census extracts:—

	Invested Capital	Value of Product
1916	$42,239,693.	$30,592,833.
1919	66,673,667	94,855,759.
Increase	58 per cent	210 per cent

It may therefore be expected that there will be a rapidly growing demand for power.

SASKATCHEWAN

Saskatchewan possesses available water power to the extent of 513,000 h.p. at ordinary minimum flow and 1,088,000 h.p. for maximum commercial development, but none has yet been developed. That within the settled districts in the southern portion of the province is largely on wide rivers possessing little fall, so that a large demand for power must first exist to justify the cost of the necessary dams. In the northern half of the province there are fine water powers available for future needs and good lignite south of Churchill river.

Coal

The chief power resources for present needs is in the vast beds of lignite in the southern half of the province and it appears assured that the work of the Lignite Utilization Board of Canada will shortly: "result in the establishment of an industry of national importance" and that this fuel will be made available at favorable prices for all purposes. The process developed by the Board results in producing one ton of briquettes, equal in heating value to anthracite, from two tons of inferior fuel. In his evidence before the Special Committee of the House of Commons on the Future Fuel Supply of Canada last May the president of the Lignite Board said that the price of anthracite in Winnipeg was then $25. per ton and that: "It is difficult to think that we should rise above $12. (for briquettes), although I do not want to be quoted."

The deposits are estimated at 65,943 million tons. These occur mainly along the whole width of the extreme south and over a large area from the southwest border towards the neighborhood of Saskatoon, these areas being well served by railways; the chief production is in the Estevan district. Deposits are also reported at Lac La Ronge, south of Churchill River, and are said to be of better quality than that in the south. The quality generally is low but some of the seams being mined are from 8 to 15 feet thick.

The province is not yet a factor in the coal situation of Canada, the annual production being under 350,000 tons, but it appears that the work of the Lignite Board will soon cause it to become so.

Oil

While traces have been found they have not been in commercial quantities and the opinion seems to prevail that the geological structure does not warrant the expectation of this.

Market for Power

Saskatchewan is the leading grain producing province. The southern part is of the Plain Region, but the northern part is of the Laurentian plateau, underlain by rock and having some mineral possibilities. The manufacturing development has so far been comparatively small, but as the population is now over 760,000 it is likely to considerably increase. Many large milling plants exist and development may be expected in the manufacture of leather, wood-products, bricks and pottery, flax, wool, etc. The forest resources are considerable and in addition to supplying local needs, quantities of sawn lumber are shipped out of the province.

MANITOBA

Manitoba possesses exceptionally large and well distributed water power resources. The available power at minimum flow is 3,270,000 h.p. and the maximum commercial development would be about 5,770,000 h.p., of which some 250,000 h.p. is now developed or under construction for the supply of Winnipeg and district.

Coal

In coal resources the province possesses about 176,000,000 tons of lignite at Turtle Mountain in the extreme south but this supply has not yet been appreciably developed and practically all coal is imported. It is probable that Manitoba will draw largely on the Saskatchewan supply when the briquetting industry is established (see remarks under "Saskatchewan") and later develop a similar industry of her own.

Of oil or gas in commercial quantities there appears little prospect as the geological formation is considered unfavorable.

Manitoba is therefore, particularly lacking in discovered fuel resources within her own borders but has such abundant and well distributed water power that future power requirements are well provided for.

Market for Power

The thickly settled portion of Manitoba is mainly within a very small portion of the province south of Lake Winnipeg. In population and value of manufactured products it ranks as the fourth province of the Dominion and the manufacturing progress of the principal cities is quite marked; Winnipeg now ranks (1919 Census of Industry) in all respects as the fourth manufacturing city in Canada.

This "prairie province", of which only 5% is prairie and 75% is covered by forest, produces in the north copper, gold, silver and other metals, gypsum clay, shale, limestone, timber, etc., extensive mining developments having taken place in the Le Pas and Rice Lake districts. Manitoba "must henceforth take an important place amongst the mineral producing areas in Canada, particularly in the output of copper and gold." (Commissioner of Northern Manitoba). The mineral production in 1920 was $3,900,000.

It will therefore be seen that the power demand is already large and that it is likely to increase rapidly over a wide area.

Built-in-Place Gunite Water Conduit

Unusual Design and Cement Gun Construction Produce an Economical Low Head Conduit—Details, Costs and Solutions of Special Problems

The Water Department of the city of Tacoma, Wash., U. S. A., completed during the summer of 1921 the construction of a built-in-place gunite water conduit, which, on account of some novel features both in design and construction, should prove of interest to many engineers. This description of it is therefore printed. It is by W. A. Kunigk in "Engineering and Contracting."

The gunite conduit replaced two wooden pipe lines of various diameters, and serves the purpose of collecting the discharge from 12 wells strung out over a distance of ¾ of a mile south of Pump Station "C," located at South 63rd and Cedar Sts. The conduit empties into a small reservoir at the pump station.

Quantity, Pumping and Measurement

The wells are of the driven type, 12 in. in diameter and cased. Their average depth is about 135 ft., with a total yield of approximately 15,000,000 gal. per 24 hours, and a maximum yield per well of approximately 1,500,000 gal. per 24 hours.

The water is raised to the surface in these wells by a so-called air lift system, air being supplied from compressors located at the pump station through two pipes which are connected to the individual wells. In order to keep a close check on the yield of this system each individual well discharges into a concrete weir box where most of the air is liberated and the flow can be measured by ascertaining with a hook gauge the head over a sharp crested weir. From the weir box the water discharges into the conduit and is then conveyed by gravity to the pump station reservoir. Just before entering the reservoir the water passes through a screen chamber and then over a sand box where slight accumulations of sand are removed and the water is also chlorinated. From the reservoir the water is pumped into the high service district of the distribution system. All compressors and the pumps at this station are electrically operated and the station can be started at a moment's notice.

Character of Service and Operation

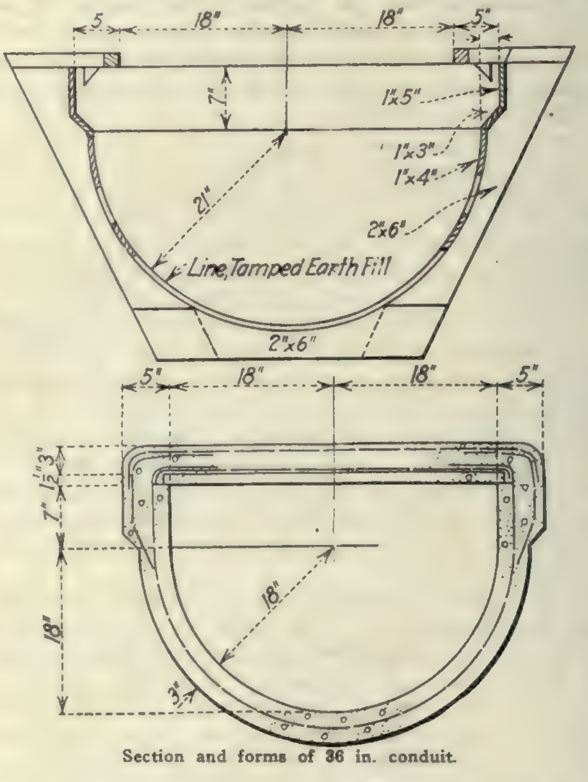
This air lift well system is maintained by the Tacoma Water Department as an auxiliary supply, and is called upon in case of a break in, or necessary repairs to, the Green River gravity system which constitutes the principal source of supply for the city of Tacoma. It may also be used for the purpose of boosting the pressure from the gravity supply system during the sprinkling season of the summer months when the rate of demand at times equals or exceeds the rate of supply.

The intermittent operation of the well system, coupled with the fact that the pressure on the collecting pipe at any point does not exceed 10 lb. per sq. in., contributed greatly to the rapid decay of the old wooden collecting pipes, some parts of which were entirely decayed after about 10 years of service.

Design for Economical Construction

The peculiar horse-shoe cross-section of the conduit was decided upon with the idea of facilitating the application of gunite, permitting the cement gun nozzleman to do all shooting from alongside the ditch, with the advantage of eliminating the use of inside forms. Two sections were designed, the smaller section measuring 24 in. and the larger section measuring 36 in. across underneath the top slab. The semi-circular part of the small section is made of gunite 2½ in. thick, and increased to 4½ in. in thickness at the construction joints below the pre-cast slab. The bottom part of the section is reinforced with a single layer of American Steel & Wire Company's triangular mesh, No. 093 being used where the head was 6 ft. or less and No. 126 mesh being used where the head was from six to 23 ft. The gauge of the wire mesh around the corners was also varied in a similar way according to the head.

The pre-cast slab across the top was made of 1:3 cement mortar 1½ in. thick and reinforced with No. 126 mesh. These slabs were intended to carry only the weight of gunite during construction or the weight of a man temporarily while the top steel was being assembled and the top cover of gunite was being shot in place. The top slab was made of gunite 2½ in. thick, and was designed independently of the pre-cast slab. A maximum backfill of 5 ft. was assumed, and various heads up to 23 ft. were provided for in the reinforcement, water and backfill stresses being considered to act independently. The lower part of the top slab was reinforced with No. 093 mesh, and the upper part was reinforced with the same gauge mesh for heads of 6 ft. or less and with No. 153 mesh for heads from 6 to 23 ft.



Section and forms of 36 in. conduit.

No expansion joints are provided, and temperature stresses are taken care of by seven 3/8 in. round corrugated bars spaced equidistant around the periphery and lapped 15 in. at splices. All gunite used in both small and large sections was of 1:3 mix, cement and sand respectively measured in loose volume. The gunite in the weir boxes and the pipe connections was of similar mix.

The semi-circular part of the large section of the conduit is made of gunite 3 in. thick and increased 5 in. in thickness at the construction joints under the pre-cast slab. This part is reinforced with a single layer of No. 093 mesh and an additional layer of No. 153 mesh is provided around the corners. The maximum head on this section is assumed at 6 ft. The pre-cast slabs for this conduit were made of the same mix and thickness and reinforced with the same gauge wire mesh as those for the smaller conduit. The top slab was made of gunite 3 in. thick and was designed for a maximum backfill of 5 ft., and for heads as stated before. The reinforcement consisted of two layers of No. 153 mesh placed near the top and bottom. The temperature stresses in this section are provided for by eleven 3/8 in. round corrugated bars spaced equidistant around the section.

Unit Stresses

The maximum unit stress for gunite in the top slab of the two sections was limited to 900 lb. per sq. in. The maximum unit stress for the wire mesh was fixed at 16,000 lb. per sq. in. However, the exactly economic gauge of wire mesh could not be obtained and the next heavier stock sizes were selected. On account of the extra reinforcement around the corners the top and bottom sections were considered to act monolithically.

Lamp Holes and Manholes

The entire line south of the pump station is provided with alternate lamp holes and manholes at all points of change in grade or alignment as in sewer construction, so that any section of the line may be readily examined. With the exception of one lamp hole which was made of wrought iron pipe, all of these have been built of gunite 3 in. thick reinforced with wire mesh, shot from the outside over collapsible forms or over thin sheet metal forms left in place. All lamp or manholes are provided with galvanized iron hoods.

Weir Boxes

The original plan was to build all weir boxes of expanded metal to be plastered inside and out with cement mortar, but this idea was abandoned after the first weir box had been built in this fashion. It was found that they could be built of gunite at a greatly reduced cost in a manner similar to that of the lamp or manholes, that is, over an inside collapsible form. On its inside each weir box is provided with a galvanized sheet iron baffle plate and a sharp crested weir. In the top slab is left a 12 in. diameter opening covered with a galvanized sheet iron hood to provide the necessary outlet for air.

All outside exposed surfaces of gunite were left in their natural finish without troweling or brushing. They resemble very much the so-called stipple finish and have a pleasing appearance for this class of work. Two weir boxes were built 18 ft. above the ground on elevated concrete platforms in order to raise the weir crests above the elevation of the hydraulic gradient at these points.

Construction Plant

The cement gun outfit for this work consisted of one N-1 and one N-2 cement gun. The mixing plant consisted of one sand-drier, one 4 cu. ft. gasoline concrete mixer and one rotating screen, all housed under a canvas roof. The cement guns were moved along as the pipe work was progressing. Usually about 400 ft. of pipe was built from one set-up of the cement gun, thus limiting the length of the material hose to 200 ft. When construction work began the mixing plant was set up near the pump station, and after about half of the pipe line had been built it was moved to a convenient place along the line about 1,000 ft. from the south end. In this manner all gunite material for the entire line was distributed from only two mixing stations. A 1-ton Ford truck took care of the hauling of this material to the cement guns, handling about 1 cu. yd. per trip.

Improvised Bending Equipment

The cutting and bending of the wire mesh was all done near the pump station, a homemade roll consisting of three 6 in. diameter wooden rollers covered with old belting and supported on a wooden frame in the shape of an equilateral triangle being used for the bending or straightening out. The upper roll was provided with a crank on one end and could be raised or lowered in a slot so that by passing the mesh between these three rolls it could be given the desired curvature for the lower section of the gunite flumes, or could be straightened out as was necessary for the slab reinforcement of the upper sections. This device was found to be very simple and effective in taking care of the bending of all the wire mesh used.

Sand Drier and Screw

The sand drier consisted of a 6 ft. by 10 ft. plate of 3/16 in. steel supported over a firebox and circulating duct built into the ground and lined with 1:3:6 concrete, connecting with a 10 in. sheet iron stack. For fuel slabwood in 4 ft. lengths was used. The screen consisted of a 2 ft. diameter by 6 ft. long steel wire drum having four meshes to the inch. This drum was fastened to a central shaft by three spider frames with the shaft supported in boxing resting on a wooden frame in a slightly inclined position. The screen was operated by a small gas engine connected through a belt and bevel gear.

Air Drier

A very desirable piece of equipment for the cement gun work on this job was an air drier. On some previous work on which a cement gun was used by the Water Department during extremely wet weather considerable trouble developed on account of the moist air condensing in the air line leading to the gun. This condensed water would get in the bottom of the gun and mix with the cement and sand and choke up the feed wheel about every half hour, thereby, of course, stopping all operations. The writer came to the conclusion that if dry air could be supplied there should be no trouble in operating the gun regardless of weather conditions. An air drier was therefore made, consisting of a welded tank of No. 12 gauge steel, 20 in. in diameter, and 4 ft. 6 in. long, provided at each end with a 2½ in. pipe connection and at the bottom with a ½ in. pit-cock and with a hand hole on top. Near the outlet end before it was welded a ¼ in. mesh screen of galvanized iron was inserted. This tank was filled through the hand hole with coke, and then cut into the air feed line near the cement gun with the pit-cock left slightly open for the purpose of blowing off the accumulating water. No trouble has been experienced by the writer in using the cement gun in wet weather wherever this simple device was used. The reduction in air pressure on account of the use of the air drier was negligible.

All pre-cast slabs were made in a temporary shed alongside the pumping plant on flat forms which were piled on top of each other, leaving about 1 in. of space between forms. This permitted the sprinkling of the slabs while they were curing and also provided for air circulation.

Organization and Method of Construction

In constructing the gunite conduit it was desirable that as many operations as possible should be carried on simultaneously so as to reduce to a minimum the time during which the emergency water supply from Pump Station "C" would not be available for the city's use. The work was therefore laid out and carried on with the idea of keeping as much of the old collecting system intact as was possible without seriously interfering with the progress of the new work. The rate of progress was, of course, limited by the output capacity of the two cement guns which the Water Department had available for this work. After the work had been gotten fully under way the various operations were carried on as follows:—

A crew of 20 to 40 men made the excavation, trimming the ditch to the required grade and line, and put in temporary crossings at all street intersections. Then followed a gang of from 2 to 5 men with a carpenter setting the forms in the ditch to grade. The forms consisted of girths spaced 4 ft. centers, sawed out of 2 in. by 6 in. lumber, lined with 1 in. rough boards of a cheap grade conforming to the outside form of the lower section of the conduit. The girths were all cut at the sawmill according to templates furnished, and the forms were assembled alongside the ditch in 12 or 16 ft. lengths. In setting the forms to grade and line in the ditch the lower quadrant of the circular section was left open as shown in Fig. 1, the backfiill of the quadrant was tamped to the required curvature, and the sides were then backfilled to the top of the forms. A crew of two or three men would then follow to place and wire the reinforcement for the circular section of the conduit. After the steel was assembled the wire mesh was raised the proper distance above the bottom of the forms and fastened with nails to the molding strips which formed the construction joints. Following came the cement gun crew consisting of one nozzleman, one helper assisting in moving of the material hose, one man with air hose, one cement gun operator, and one helper feeding the gun.

Rebounding Sand and Cleaning Problems

For the shooting of the lower section, the N-2 gun was used. When starting on this work considerable difficulty developed in disposing of the rebounding sand which would accumulate in the bottom of the forms ahead of the gunite work and was hard to remove from between the wire mesh reinforcement. The nozzleman would stand alongside the ditch and shoot the side opposite him and then, changing his position to the other side of the ditch to complete the half-circle, he would find so much rebound accumulated that it was practically impossible to prevent sand pockets in the gunite. After some experimenting the following method of overcoming this difficulty was evolved: A ¾ in. air hose was connected to the main air pipe and fitted at the end with a 4 ft. length of ¾ in. pipe hammered out at the discharge end to a flat nozzled tip. This air nozzle was operated by a laborer immediately ahead of the cement gun nozzle, always keeping the reinforcement clean and ready for the application of the gunite.

The accumulating sand was disposed of by blowing it into the space below the open part of the form where the ground had purposely been kept somewhat below grade. About every 10 to 15 ft. of conduit the cement gun nozzleman would operate his nozzle with air and water only, thoroughly cleaning and wetting the forms ahead and also leveling off the sand below the reinforcement. In order to make the inside as nearly as possible true to line the nozzleman's helper would carry along a light wooden template conforming to the inside outline of the conduit. With this he would keep a close check on the work as it progressed, always pointing out to the nozzleman any slight variations in the gunite from the true line.

Finishing and Curing

Following the cement gun crew would be a cement finisher and his helper. In order that the finisher might work close to the nozzleman a canvas shield on a light wooden frame was always kept between the nozzle crew and the finishing crew. In this way the finisher was not bothered with flying sand which otherwise would have been troublesome on windy days. The finishing was done with a steel trowel after all surplus material had been removed with a straight edge by the helper. A very smooth surface was obtained in this way, equal in every respect to that of a pre-cast pipe. This surface was kept wet from four to six days and protected against the rays of the sun on bright days by portable canvas awnings mounted on 4 ft. by 12 ft. wooden frames. However, during the construction work considerable rainy weather was encountered which, of course, was conducive to producing a well-cured concrete. The cement gun crew and finishing crew would on such days work under canvas covers stretched over light portable wooden frames and practically no time was lost on this account except on a few days when the rain was accompanied by high winds.

Following the finishers came a crew of from two to four men who removed the molding strips which formed the construction joints and then laid the pre-cast slabs. These slabs were laid with the troweled side downward in a 1:3 cement mortar and were also joined endwise with a mortar joint, all joints on the inside of the conduit being struck off.

Top Construction

The pre-cast slabs were made of 1:3 mix, using in the sand all of the rejected material from the rotating screen. They were cast by a crew of three men in a temporary construction shed on three sets of oiled wooden platforms provided with collapsible frames. The wire mesh reinforcement for these slabs was held in place by a couple of No. 16 gauge wires drawn through the frame. The upper side of all slabs was steel troweled as this was the side that was to come in contact with the water when the conduit was completed. Usually the slabs were kept wet for about eight days, but often were taken out of the frames three days after they were poured and then stored, standing on end until used. Considerable trouble from breakage was anticipated by the men who were to handle the slabs, but not over seven or eight slabs were broken on the entire job, and some of these broke because they were dumped off the truck that distributed them along the line.

Following the crew placing the slabs came another small crew placing the reinforcement for the top slab. Then came the gunite crew shooting the top slab in place with an N-1 gun which has about 25 per cent. less capacity than the N-2 gun, which was used in shooting the bottom. In shooting the top, great care was exercised in thoroughly wetting the pre-cast slabs and in making a perfect junction with the old gunite at the corners. Finally came the finisher and his helper, troweling off the top and taking proper care in protecting the green gunite.

The distribution of all the material for the cement gun, the forms, the reinforcing steel, the pre-cast slabs, etc., was handled by a 1-ton truck. On days when it did not rain the green gunite was kept wet by sprinkling and after 3 or 4 days was covered with about 3 in. of the excavation material which was then kept wet for another 4 or 5 days.

In joining the gunite work of consecutive days, the only precaution taken was that of running the end of a day's gunite work out to a feather edge over a distance of about 12 in. The next morning the new work was joined after a thorough cleaning and wetting of the end of the preceding day's work and not the slightest leakage has appeared at any of these joints.

Final Tests

A working test was made 28 days after the last gunite was shot and only a few small damp places could be detected at the construction joints immediately below the flat slabs. The water was left standing in the gunite pipe for a number of days, but no appreciable lowering of water level could be detected in the standpipes, and the conduit was then put in service. The conduit has now been in operation through one summer and one winter season, and has withstood temperature changes from 90 degrees to 10 degrees above zero without the slightest sign of distress.

Cost Data

The total cost of this construction work was $40,053.31, distributed over the different items as shown in the following statements:

2,900 ft. of 36-in. conduit at $5.37 per ft.	$15,573.00
1,732 ft. of 24-in. conduit at $3.61 per ft.	6,252.52
Excavation, backfilling, reclaiming and dismantling of old wooden pipe and connections	7,892.80
13 weir boxes, 2 concrete weir box stands, 3 standpipes, 5 lamp holes, weir box connections, changes in reservoir connections, new air line connections for wells, blow-offs, railing, etc.	8,884.99
Engineering, testing and office expense	1,450.00
Total cost of work	$40,053.31

The wages paid for laborers, superintendents, etc., were as follows:

Construction engineers, per month	$175-200
Sub-foreman on excavation and reclaiming of old pipe and dismantling of connections, per day	$5.50
Carpenters, per day	7.00
Cement finishers, per day	7.00
Cement gun nozzle operators, per day	7.00
Cement gun operators, per day	4.75
Team and driver used in backfilling, per day	9.00
Laborers	4.75

The labor cost of the cement gun organization using one N-1 and one N-2 gun was as follows:

2 nozzle operators at $7.00 per day	$14.00
2 nozzle operators' helpers at $4.75 per day	9.50
2 air nozzlemen at $4.75 per day	9.50
2 cement gun operators at $4.75 per day	9.50
2 cement gun operators' helpers at $4.75 per day	9.50
2 cement finishers at $7.00 per day	14.00
3 laborers helping cement finisher and wetting and looking after protection of pipe at $4.75 per day	14.25
5 laborers drying, mixing and screening material at $4.75 per day	23.75
1-ton Ford truck (¾ time) at $4.00 per day	3.00
1 driver and 1 helper each (¾ time) at $4.75 per day	7.12
1 superintendent (4/7 time) at $7.00 per day	4.00
Labor cost per 8-hour day	$118.12

Daily quantities of gunite and labor costs per cu. yd. placed were as follows:

Gunite placed per 8-hour day	12.02 cu. yds.
Cost of placing per cu. yd.	$9.83

Output of N-1 gun equaled 5.15 cu. yds. per day.

Output of N-2 gun equaled 6.87 cu. yds. per day.

The prices paid for material delivered at the site were as follows:

Cement	$ 3.20 per bbl.
Sand or gravel	2.75 per cu. yd.
Lumber, average price	18.00 per M. ft. BM.
Reinforcing steel, ⅜-in. corrugated bars	5.50 per cwt.
A. S. & W. Co. triangular mesh—	
No. 153	4.77 per 100 sq. ft.
No. 126	4.02 per 100 sq. ft.
No. 093	3.22 per 100 sq. ft.

The itemized cost per lineal ft. of the 36 in. conduit was as follows:

	Per lin. ft.
Forms (labor and material)	$ .43
Cement	1.12
Sand	.50
Reinforcement (material only)	.95
Reinforcement (labor of cutting, bending and placing)	.34
Gunite (labor of placing)	1.15
Pre-cast slabs (labor and material)	.79
Depreciation of plant and cost of air, etc.	.09*
Cost per lin. ft. in place	$5.37
Cost of excavation, reclaiming of old pipe and backfilling	1.70
Total cost per lin. ft.	$7.07

The itemized cost per lineal ft. of the 24 in. conduit was as follows:

	Per lin. ft.
Forms (labor and material)	$ .43
Sand	.30
Cement	.67
Reinforcement (material only)	.58
Reinforcement (labor of cutting, bending and placing)	.34
Gunite (labor of placing)	.66
Pre-cast slabs (labor and material)	.58
Depreciation of plant and cost of air, etc	.05*
Cost per lin. ft. in place	$3.61
Cost of excavation, reclaiming of old pipe and backfilling	1.65
Total cost per lin. ft.	$5.26

*See text explaining low cost of air.

Depreciation Air Cost, and Gunite Quantities

The cross-sectional area of the gunite in each conduit as built was approximately 10 per cent greater than the neat dimensions shown on the plan and was so taken in analyzing the cost of the gunite work. The principal reason for this was the open section of the forms at the bottom and also a slight increase in the thickness of the top slab. In considering depreciation a plant investment of $4,400 was charged against this work for a period of 3 months on the basis of 3 per cent per month. This gives a total depreciation of $396. In this equipment were included one N-1 and one N-2 cement gun with all the necessary material, air and water hose, one 4 cu. ft. gasoline mixer, one air-dryer, one sand dryer, one rotating screen with gas engine, canvas covers and awnings, fittings and necessary piping. The cost of air for the cement gun on this work was very small as it was furnished from one of the electrically-driven compressors at the pump station. The station attendant operating the compressor was not charged to this work, and power was furnished by the municipal light and power plant at ½ cent per kw.h.

Conclusions

From close observation during the progress of the work the writer draws the following conclusions:

The section of the conduit as built was very well adapted for doing effective gunite work, the nozzleman always working to good advantage regardless of what part of the conduit he was working on. It is important in planning gunite work that the nozzleman be enabled to shoot at the surfaces as near as possible with the material nozzle in a position not less than 3 ft. away from the forms, pointing the nozzle at a right angle to the surface. When, on account of obstructions, the nozzleman is compelled to shoot at a surface at an angle considerably less than 90 degrees, the result will be that the gunite will build up in riffles like a sandy river bottom and will not be dense and uniform. An excessive amount of rebound will also result from this cause. It is also desirable to have, if possible, only one layer of reinforcement in a gunite section. This will tend to keep the rebound down to a minimum. For reinforcement wire mesh is preferable to bars. If bars must be used then the bars should be round. Square bars have a tendency to produce a small triangular area of rebound material back of the bars which contains practically no cement at all.

A large section of conduit could be built at considerably less cost per cubic yard of gunite in place because there would be less loss in time in moving equipment along the ditch and a smaller proportion of loss of material, and also less expense in finishing. The principal advantage in constructing the conduit section as designed was that all crews could work simultaneously without interfering with each other, and that there was no delay on account of removing inside forms which is one of the troublesome features attending the building of a continuous concrete pipe of small cross-sectional area. For obvious reasons this type of conduit would not be economical for heavy pressures, for which condition a circular section should be adopted.

The best results in guniting were always obtained when the material hose was 100 ft. or less in length; 250 ft. was the maximum length of hose used on the job. Air pressure should preferably be not less than 35 lb. per sq. in. at the gun, and water pressure should be greater than the air pressure by at least 10 lb. per sq. in. A mistake is often made in gunite work in using sand that is absolutely dry. The writer finds that the best results can be obtained when sand retains from 5 to 7 per cent moisture. The tendency to dust at the nozzle will then be eliminated and the material will not separate even in a long line of hose. The air, however, must be delivered dry to the gun.

For purposes oof comparison with circular conduits the equivalent diameter of the 36-in. gunite was assumed at 31-in., and the equivalent diameter of the 24-in. gunite conduit at 20-in.

The method of constructing gunite pipe as developed on this work is not patented, nor does the writer intend to take out a patent thereon. The work was designed and constructed by force account under the personal supervision of the writer, with O. A. Abelson as designing engineer and J. A. Kuehl and R. Bergerson as constructing engineers.

Bank of Toronto to Build in Vancouver

On a centrally located site, close to the corner of Hastings and Granville Streets, the Bank of Toronto is soon to commence construction of a three-storey office building. The site was secured some months ago and is at present occupied by a brick structure, one of the oldest on Granville Street. The plans for the new building have not yet been completed, but it is the intention to have one of the most modern banking offices that has yet been built. It is intended to have the exterior of Haddington Island stone, a high-grade sandstone of most pleasing appearance and of excellent quality, which has been used in many of the best public and semi-public buildings on the coast. The banking office will occupy the whole floor, the frontage of the building to be fifty feet. The interior height of the chamber will be thirty feet. Business offices in the upper stories will be for rent to the public.

Concrete Roof Tile Machine

Mr. T. Skat-Peterson, Beaverton, Ont., is acting as sole agent in Canada for the "Ideal" and "Favorit" cement roof tile machines, which have been developed to manufacture colored concrete roof tiles, similar in design to the Spanish clay tiles. The "Ideal" machine produces 2,000 to 3,000 tiles per day, by an entirely automatic process, the labor required being only one man and a boy. Electricity is the motive power. The "Favorit" machine is smaller and lighter and is suitable for a moderate sized concrete products factory. The tiles produced by this process are very durable, easily applied and handsome in appearance.

Mr. Skat-Peterson also handles the "Triumph" concrete pipe machine, which is claimed to produce pipes that are very strong but cheap.

The Thew Shovel Company, Crain, Ohio, have recently issued two bulletins, descriptive of their products. Bulletin 201 completely illustrates and describes the type 0 electric shovel, and bulletin 501 contains specifications of type 0 cranes, driven by steam, gasoline and electricity.

Trade Incorporations

Lime Products, Limited, with head office at Montreal, capital $250,000, to manufacture and deal in lime, plaster, cement and other building materials.

C. Brankston & Sons, Limited, with head office at Toronto, capital $40,000, to carry on the business of contractors and builders.

Inter-Provincial Plastering Co. Ltd., with head office at Windsor, Ont., capital $10,000, to do a contracting business in lathing and plastering.

H. A. Foster & Co. Ltd., with head office at Montreal, capital $50,000, to carry on the business of contractor and building supply dealer.

Ontario Marble Co. Limited, with head office at Peterborough, Ont., capital $200,000, to carry on the business of mining, quarrying and manufacturing marble, granite and limestones.

The Contract Record's

Weekly House Suggestion No. 18

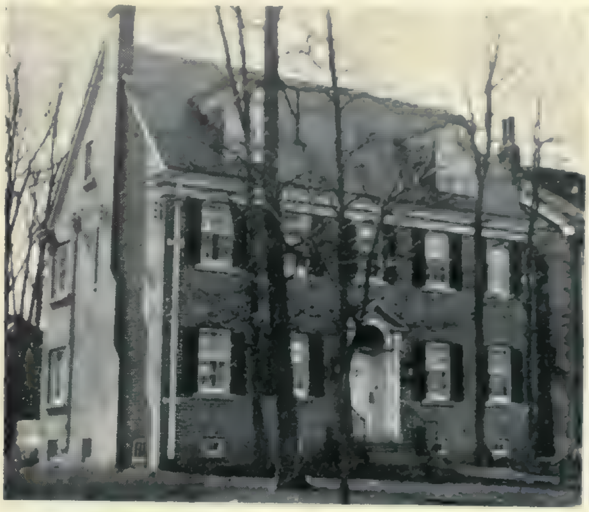
The large brick residence illustrated herewith was completed recently for Mr. J. F. Brown, on Lyndhurst Avenue, Toronto. The main feature of the simple but smart appearing front exterior is the beautiful entrance, seen in the illustration, which is finished in white enamel, stone steps and wrought iron railings. The brick with their well defined joints, the plain windows with their white enamelled sash and green shutters, the white enamelled eavetroughs and waste pipes, and the slate toned shingle roofing all combine to form the clean cut exterior appearance of this house and suggest careful attention to architectural detail.

The house is on the square plan, the ground floor being divided into two equal sections by a wide, through hall, at the end of which is a toilet, finished with tile floor and wainscotting. The living room and dining room are situated on either side of the hall, as seen on the accompanying ground floor plan, and are entered through double French doors.

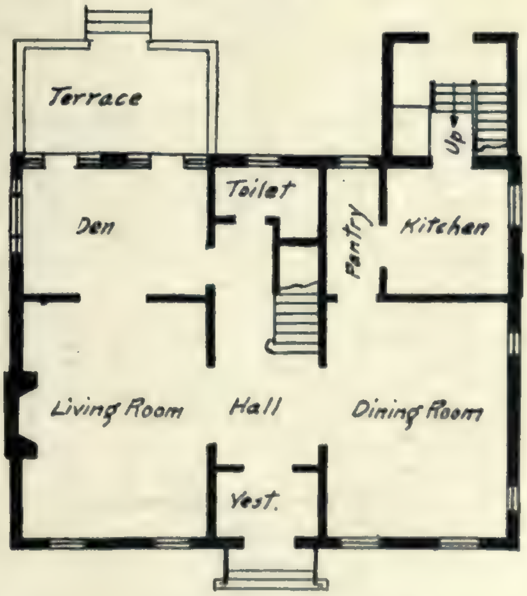
The den, at the rear of the living room, is entered from that room by double French doors and also has an entrance on the hall. There is a terrace off the den, as seen on plan, entered through two single French doors. This terrace is laid with a red tile floor. The kitchen and pantry are located at the rear of the dining room and are equipped with built-in cupboards, cabinets, etc. The porch at the rear of the kitchen accommodates the refrigerator and is equipped with a milk closet in the rear wall. The flooring throughout the house is of oak.

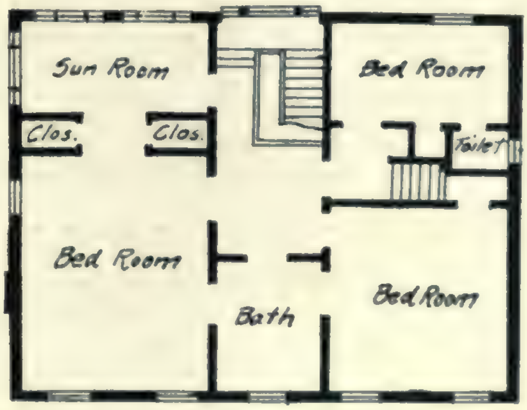
The first floor contains three large bedrooms, sun porch and two bathrooms and toilets. The main bathroom is conveniently situated at the front end of the main hall, with entrances from the hall and from the two front bedrooms, and is equipped with built-in medicine cabinet and opening to metal clothes chute to the laundry in the basement. The floor and wainscotting in this room, as well as in the smaller toilet shown on first floor plan, are of white tile. The smaller bedroom at the rear, equipped with separate toilet, might well be utilized as the maid's bedroom. This room, as are all rooms on this floor, is amply supplied with linen and clothes closet space. A feature of beauty, which is worthy of particular mention, is the 8 ft. landing on the main staircase to the first floor, which has a large window the entire width of the landing, equipped with a metal lined flower box.

There are three good-sized bedrooms, small storage room, trunk room and large bathroom in the attic, all conveniently located off a square hall and all adequately equipped with linen and clothes closet space. The decoration of this floor and first floor, as in the case of the ground floor, is carried out in white enamel and mahogany.



The house was designed by N. A. Armstrong Company Ltd. Architects and Industrial Engineers, 7 King St. E., Toronto.





Mainly Constructional

East and West—From Coast to Coast

The Dominion Government has approved the plans of the City of Toronto for the construction of a new bridge across the Don River at Gerrard Street and tenders have been called.

The Thomson-Kneeland Lumber Co. Ltd., have opened their office and yard at 344 William St., Montreal. They carry a stock of building lumber of every description, together with stock doors in pine and fir, hardwood flooring, hardwood trim, etc.

It is announced that the newly organized Hochelaga Cement Co. Ltd., at Montreal, plan the erection of a plant on their property in Montreal East, to produce 2,500 barrels of cement per day, with provision for expansion to double this production.

A report from British Columbia states that between forty and fifty operating engineers employed on the Northern Construction Company's work at North Vancouver and on the Ballantyne Pier contract have gone on strike against a proposed reduction in wages from $6.40 per day to $6.00.

A delegation composed of the following gentlemen from British Columbia, recently waited on the department at Ottawa to urge continuation of the work on the drydock at Esquimalt, B. C.; Hon. J. Hart, provincial minister of finance; Messrs. H. C. Hall and W. V. Ivel, of Victoria, and T. B. Booth of Nanaimo.

In the course of a recent address Hon. E. D. Barrow Minister of Agriculture of British Columbia, said that 30,000 acres of land would be drained and made fit for farming by the Sumas reclamation project in that province. The total cost to the end of March was $784,737, and he estimated the total cost at $1,800,000.

Building in the township of York is steadily increasing, as shown by the building permits for the first three weeks in April. During that period the permits issued totalled $1,250,000, and this amount represents over 300 new dwellings, some garages and repairs. In 1921 the permits for the entire month of April were considerably lower than this figure.

At the annual meeting of the Corporation of Quebec Land Surveyors the following officers were elected:—president, Senator J. P. B. Casgrain; vice-presidents, D. W. Mill and T. Simard; secretary-treasurer, Arthur Smith; directors: Hon. Senator J. P. B. Casgrain, Arthur Smith, Paul Joncas, D. W. Mill, T. Simard, Paul A. Beique, F. C. Laberge, Altheod Tremblay and J. M. Roy.

The Toronto city council, at a recent meeting, passed by-laws authorizing the issue of debentures totalling $1,589,000, for the following works:—new bridge over the Don at Gerrard Street, $762,000; purchase of land for Boulevard Drive between Dowling Avenue and Dufferin Street, $210,000; harbor improvements at Sunnyside, $411,000; site for new Observation Home, $25,000; Nurses' Home, in connection with the Isolation Hospital, $100,000.

The builders, supply men and merchants of Hamilton are busy planning for the Better Homes & Industrial Exposition, to be held in that city from June 5 to 10. Nearly half the booths available have been taken up and many attractive and novel exhibits are being planned. One local contractor, who has taken three booths, will construct a miniature home, complete in every detail, and a local roofing concern have experts working on a mechanism to produce an artificial rainstorm to exhibit the waterproof qualities of their product. Judging from the interest evidenced to date, Hamilton's first Better Homes Exposition should be a huge success.

Personal

Mr. James F. McLaren will succeed the late Wm. Scott as assistant superintendent of the Island filtration plant at Toronto.

Mr. Ivan Vallee, chief engineer of the Quebec Department of Public Works, left Quebec City for Montreal recently, where he will inspect several bridges under construction in that district.

Mr. John E. Moore, of St. John, N. B. has been appointed by the Minister of Labor to represent the British Empire Steel Corporation's interests on the conciliation board which will adjust the existing wage dispute with the men at Sydney, N. S.

Messrs. Thomas Longworth, K. D. Johnson and Dr. Lovering were recently elected as advisory commissioners on the city council at Lethbridge, Alta., to assist the present civic commission, which has looked after the administration of civic matters, under this new form of government, since 1914.

Mr. Walter J. Francis, the well known consulting engineer of Montreal, has been appointed engineer to the Chippawa Royal Commission, which is investigating the construction of, and the expenditure on, the recently completed Chippawa power canal. Mr. Francis is a graduate of the University of Toronto.

Lt.-Col. H. C. Boyden, of Chicago, spoke recently before the Peterborough, Ont., branch of the Engineering Institute of Canada, on the subject "Recent Developments in Concrete". During the course of his lecture, Lt.-Col. Boyden discussed the results obtained in a number of field tests for getting good concrete, and the results of exhaustive tests with the use of aggregates of varying degrees of hardness, sharpness and cleanness.

Mr. J. J. C. Bradfield, chief engineer for the proposed $25,000,000 bridge structure over Sydney Harbor, Australia, arrived in Vancouver recently en route to England. Mr. Bradfied is quoted as saying, on arriving in Vancouver, "I am travelling through the United States, Canada and England and it is my duty to explain to firms wishing to submit tenders, any data they may require regarding the construction of the bridge. Tenders will be in on October 31."

Obituary

Mr. Wm. Ainlay, building contractor of Toronto, died in that city recently in his 76th year. Deceased was born in Brussels, Ont., but had resided in Toronto for the past 18 years.

Mr. Arthur Edmund Breton Hill, a well known figure in B. C. civil engineering circles, died at his home in Vancouver recently. Deceased was born at Mira, Cape Breton, in 1845, and graduated in civil engineering from McGill University in 1875. He played a prominent part in many of the province's large engineering enterprises and was the originator of the much discussed project for connecting the north and south shores of Burrard Inlet by means of a rock and earth filled bulkhead across the Second Narrows. He was a member of the Institution of Civil Engineers of England, The Engineering Institute of Canada, and a charter member of the Corporation of British Columbia Land Surveyors.

Trade Incorporations

Chippawa Sand & Towing Co. Ltd., with head office at Chippawa, Ont., capital $100,000.

Albion Paving & Construction Co. Limited, with head office at Hamilton, Ont., capital $150,000, to carry on the business of general and road contractors.

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Great Activity in the Construction Industry

The volume in building is developing. It is, in fact, the chief influence in improved business conditions in Canada. To-day, with but one exception, the construction industry is busier than it has been at any time since 1914. It is busy on private construction and that is the important thing. The public is selling out to satisfy long deferred requirements in housing, in business building and in plant facilities.

During April, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $29,428,400, compared with $13,465,000 in March, and $21,622,000 in April 1921. Residential building accounted for 42.8% of the April total, and amounted to $12,472,200. Business building amounted to $8,203,300 or 27.9% of the total; industrial buildings, $3,176,400, or 10.8%; public works and utilities, $5,576,500, or 18.5%. The amount of contemplated new work reported during April was $29,427,600.

The trend of building costs is still slightly downward. During March, the wholesale price index of 48 building materials declined 5%, and is now 79.7% above 1913, compared with a peak of 183.8% reached in May, 1920. Prices have now declined 56.6% from the high. The confidence of building investors is mounting rapidly because they are learning that we really entered the period of stabilization in building costs and that there is no danger of too great a depreciation in the replacement values of buildings constructed now.

It is time to build, comments MacLean Building Reports in this connection. The convincing proof is that thousands and thousands of projects are going ahead; that builders are finding conditions favorable, that labor is settling down to a sound basis of production, and the flow of money into building channels is increasing. Many of the big projects under-way have been undertaken only after careful study of the situation and only after the investor has come to realize that the major conditions in the building field now are favorable.

The Brantford Meeting of the Canadian Section of the A. W. W. A.

Several interesting papers are on the program which has been arranged for the annual meeting of the Canadian section of the American Water Works Association which meets at the Kirby House, Brantford, Ont., on Friday and Saturday, May 12-13. The program is as follows:

Friday, May 12

2:00 p.m.—General Business.
Election of Officers for 1922-3.
3:30 p.m.—"Government Control of Sewage," by F. A. Dallyn, sanitary engineer, Department of Public Health, Ontario.
4.30 p.m.—"Filter Plant Construction," by R. L. Dobbin, Waterworks Superintendent, Peterboro, Ont.
6:30 p.m.—Banquet at Brantford Golf and Country Club.

Saturday, May 13

9:00 a.m.—"Treatment of Impure Hard Water," by William Gore, of Gore, Nasmith & Storrie, Toronto.
10:00 a.m.—"Manufacture of de Lavaud Cast Iron Pipe," by Professor Gillespie, Toronto University.
11:30 a.m.—"Standardization of Hydrant Threads," by Norman McL. Wilson, chief engineer, Brantford Water Works.

In connection with the convention, manufacturers of water works equipment and supplies are putting on an exhibition in a room adjoining the convention hall.

The Freight Rate Situation

The following memorandum regarding freight rates has been submitted by J. C. Reilly, executive secretary of the Association of Canadian Building and Construction Industries:

In the press reports of the speech of the minister of railways and canals, in the House, April 11th, sufficient importance does not seem to have been given to his statement on the question of freight rates. I therefore quote from Hansard (p. 916-No. 24-Vol. LVII) as follows.—

"In the speech from the throne it was stated that conferences had been arranged between the railway authorities with respect to the reduction of rates upon basic commodities. A number of these conferences have been held, but, because of the uncertainty of the entire rate situation, the executives of the various railways feel that it is inadvisable, at this time, to reduce rates on basic commodities, in view of the fact that the suspension of the Crow's Nest Pass agreement ceases on July 6th next, and the Crow's Nest Pass scale of rates again becomes effective on the commodities named in the Crow's Nest Pass subsidy legislation of 1897; further, general order No. 308 of the Railway Commission, dated September 9th, 1920, does not extend beyond July 1.

The Government feels that the matter is of such importance to the people of the country—that the entire question should be placed before the members in such a way as to enable them to obtain the fullest possible information.

With this in view, I propose, at an early date, to ask the House to appoint a special and representative committee to examine into the question of rates, with power to summon the executives of the various railways and others to place before the committee all available information for the consideration of the members.

It would then be for the committee and for the House to take such action as, having regard to all the circumstances, shall commend itself to the wisdom and judgment of Parliament."

Other interesting items in the Minister's speech were:—No new construction is provided for, this being left to the new Board. Wages and fuel still remain the principal charge upon railway revenues. The operation ratio in 1921 was 112.70; in other words, it took 110.7 cents to earn a dollar, the distribution being:—wages, 65.03 cents locomotive fuel 16.88 cents, and other expenses, 30.79 cents. Railway labor is reported as being more efficient and doing more and better work.

The Meeting of the Canadian Good Roads Association in Victoria

The ninth annual convention of the Canadian Good Roads' Association, to be held at the Empress Hotel, Victoria, B. C., on June 12, 13, 14 and 15, already gives strong indications that it will be as successful as any of its predecessors, for notifications are being received by the secretary-treasurer, G. A. McNamee, of Montreal, which indicates that every provincial government as well as the federal government will be well represented at the gathering. The Hon. J. H. King, minister of highways in the federal government, and A. W. Campbell, commissioner of highways for the federal government, will represent the Dominion parliament, and will tell the delegates something of the scheme for general aid on main highways of which some provinces have taken more advantage than others.

The Hon. W. C. Nichol, lieutenant-governor of British Columbia, will formally open the convention on the morning of Monday, June 12, and will be joined in his welcome by Premier John Oliver, who has been for many years an enthusiastic advocate of good roads and who travelled across the continent to Halifax in order to speak at the convention in Halifax last year. All the members of the British Columbia cabinet have been asked by Premier Oliver to attend the sessions of the convention, while the government highway officials of the province will be present as well as road engineers and municipal delegates from all parts of the middle west and eastern provinces.

The Hon. J. L. Perron, newly appointed minister of highways for the Province of Quebec, will attend the convention, and will give the delegates some insight into the new highway law of the pioneer province in regard to highway improvement and other things. At the last session of the legislature some drastic changes were made in the highway policy with a view to ensuring the proper maintenance of the highways on which some $35,000,000.00 have already been spent, and of preventing unnecessary damage being done to the roads at periods when they are most susceptible to injury because of their softness. Several officials from the department at Quebec will accompany the minister and give the benefit of their knowledge to their colleagues.

The Hon. J. P. Veniot, minister of highways and public works in New Brunswick, has promised to attend and give an address. He is much interested in the question of uniformity of laws relating to highways and traffic, and in this connection Fred G. Pearson, of Halifax, one of the directors of the association, and president of the Nova Scotia Good Roads Association, has voluntarily undertaken the codification of federal and provincial laws with a view to assisting the labors and promoting the success of the inter-provincial conference of highway officials which is one of the features of the convention and which opens on the afternoon of the second day of the gathering.

Premier Bell or the Hon. C. W. Crosby, minister of public works, or perhaps both of them, will travel from Prince Edward Island to show their appreciation of the work being done by the association, while there will be many visitors from the United States in addition to the eminent speakers from over the border who will deliver papers on a wide variety of subjects in conjunction with their Canadian colleagues.

Ministerial representatives from Alberta, Manitoba and Saskatchewan will also be present, the latter being headed by the Hon. Sam. J. Latta, president of the Canadian Good Roads' Association and founder of the new Saskatchewan Good Roads' Association, which will send a large delegation. Some 20,000 invitations are being sent out by the association to government and municipal officials, road and machinery contractors, representatives of the automotive industry and kindred organizations. While it is expected that the delegates attending the newly formed Western Canadian Municipal Union, comprised of the municipal councils of the four Western Provinces will also be present, as their convention is scheduled to be held on June 7, 8 and 9 at Victoria. The provincial convention of the western members of the Engineering Institute of Canada will immediately follow the Canadian Good Roads' Convention, and with an interchange of delegates the success of the latter is already assured .

Changes in the Location of the Pacific Great Eastern Railway

Expert Opinion is Being Sought Regarding the Prospects of the System—Considerable Extensions are Considered Necessary to Place Road on Profitable Basis

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Owing to the increasing weight of the burden put upon the finances of the province of British Columbia by the construction and operation of the Pacific Great Eastern Railway, which was intended to link up Prince George and the rich Cariboo country with the southern coast, the Hon. John Oliver, premier and minister of railways, has recently engaged expert advice, both as to the engineering features involved in the completion and successful operation of the line, and as to the business and traffic possibilities latent in the country through which the line passes.

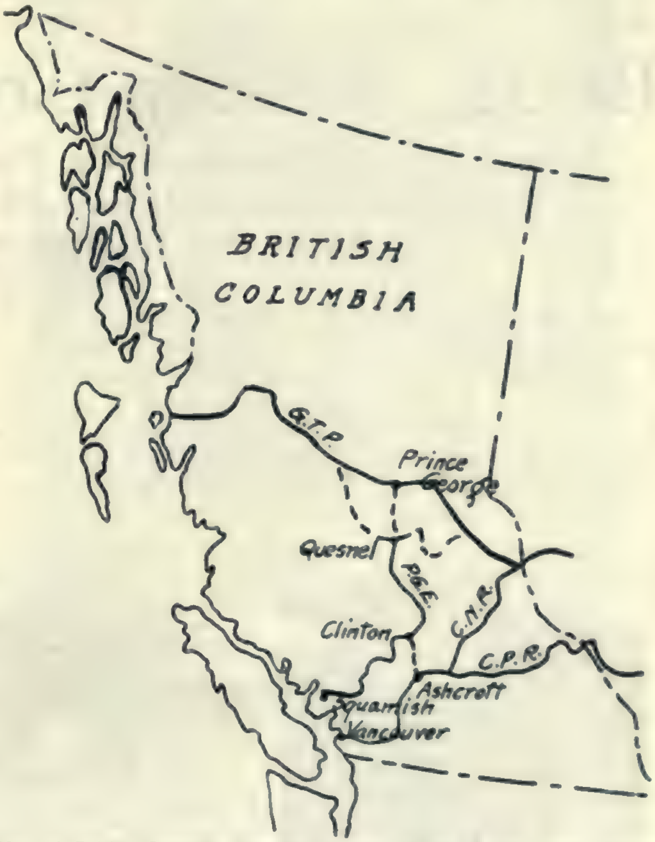
To deal with these two sides of the problem, the Government has engaged the services of Mr. Wm. P. Hinton, formerly vice-president of the Grand Trunk Pacific Railway and one of Canada's veteran railway officials, who will report on the business problems of the line, and Mr. J. G. Sullivan, M.E.I.C., consulting engineer to the Canadian Pacific Railway, who will especially advise as to the engineering side of the question in view of certain changes of location which have been proposed for portions of the line.

Experts to Report on the System

The construction programme for the current year is being held up pending the receipt of reports from the two experts. Mr. Hinton has already made his examination, but his report has not yet been tendered to the government, and in the meantime he does not wish to disclose the gist of his conclusions. He intimates, however, that the only possible hope the road has of securing traffic in sufficient volume to put the operation on a profitable basis, is for the line to be extended eastward from Quesnel instead of being constructed along the original grade, which follows the bank of the Fraser River into Prince George, where a connection would be made with the Grand Trunk Pacific. Westward of Quesnel, across the Fraser, is one of the finest ranching and dairying districts in the whole province, while going eastward the immense mining properties at Boullion, Quesnel Forks, Hydraulic, Keithly Creek, Barkerville and other famous camps could be tapped. Geologists reports show that this country is tremendously rich in the more valuable metals, though the machinery necessary for their successful development is of such a heavy nature as to necessitate railway transportation. Mr. Hinton states that an extension of the line in either of the suggested directions would prove more profitable than the proposed route up the Fraser, while it is equally possible to make a satisfactory connection with the Grand Trunk Pacific.

Mr. J. G. Sullivan will be leaving Vancouver in the course of a day or two on a trip which will cover the whole of the P. G. E. system, on which he will be accompanied by Mr. A. F. Proctor, chief engineer of the line and also chief engineer of the provincial department of railways. It is expected that he will give special attention to the possibilities hinted at by Mr. Hinton and another major item requiring consideration is the advisability or otherwise of constructing a line from Clinton to Ashcroft, a distance of forty miles, to make connection with the Canadian National system at Ashcroft.

The construction of this cut-off would have the practical effect of scrapping the remainder of the line to the coast at Squamish on Howe Sound, a distance of about 140 miles through a mountainous stretch of country with many heavy grades. The terminal at Squamish was not a part of the original scheme for the road, which according to the plans continued along the east shore of Howe Sound to North Vancouver, where connection with Vancouver itself would be obtained either by car ferry or across the projected Second Narrows Bridge, which at the time the plans were drawn was to have been constructed very shortly. A portion of this connecting link has been constructed from North Vancouver to Whyte-



Map of British Columbia showing location of the Pacific Great Eastern Railway and suggested extensions

General view of the Deep Creek bridge on the Pacific Great Eastern Railway. The distance from ground to rail is 286 ft.

cliff, a distance of twelve miles, but the remainder, along the shore of Howe Sound itself, is very heavy and expensive construction, and has never been economically justified to date. Connection with Vancouver is maintained for the main line by a car-ferry from Squamish, a distance of forty miles.

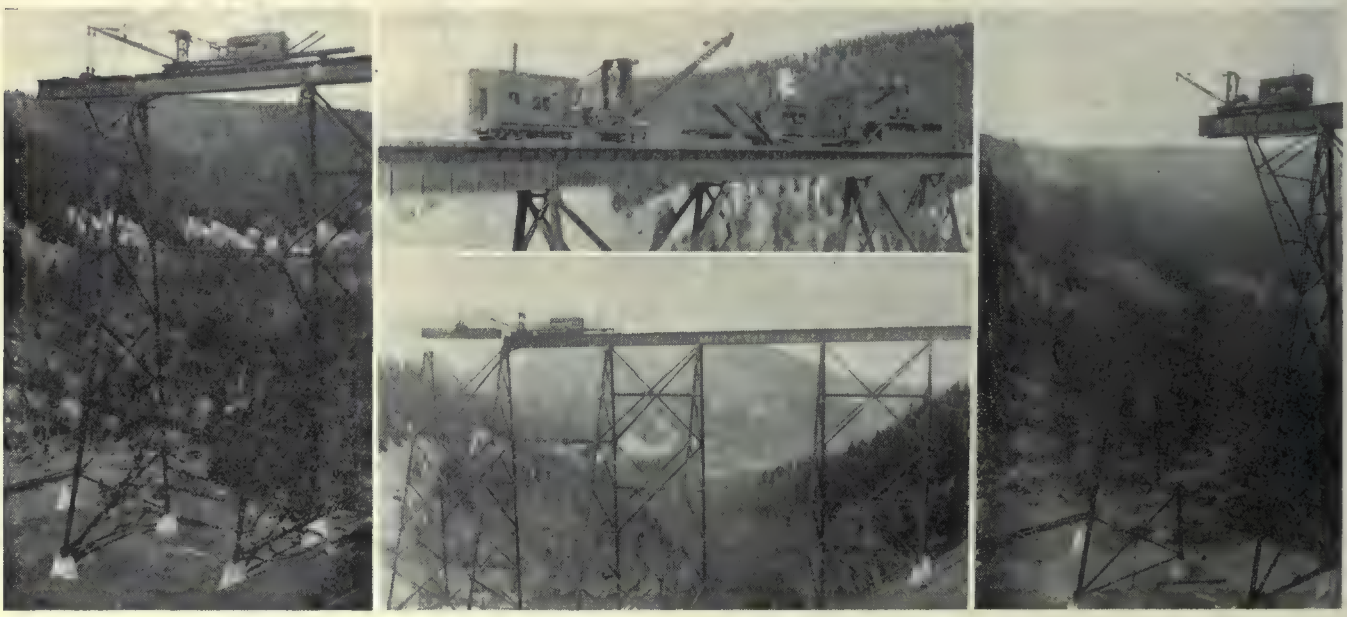
Bridge at Deep Creek is 286 feet High

Steel Trestle Structure on the Pacific Great Eastern Railway is 1,196 Feet Long and Contains 2,500 Tons of Steel—Special Erection Methods and Equipment Had to be Worked Out

By J. B. HOLDCROFT, A.M.E.I.C.

An active programme of construction has been in progress during the last two years, steel having been laid after regrading from Clinton to Quesnel. Included in this section of the line is what is perhaps the highest steel trestle bridge ever built in this country. Reference is to the bridge at Deep Creek, 1,196 feet in length and with rail level 286 feet above the bottom of the depression. The bridge consists of alternate 80 and 100 foot plate girders supported on steel towers 80 feet in length at the top. 2,500 tons of steel are contained in the structure, and the concrete in the substructure amounts to 5,000 cubic yards.

A rather disastrous accident occurred during the



Left: Placing 70 ft. cantilever girder span on bracket. Right; Tower e rection; Upper Centre: Handling complete girder span with heavy derrick car. Lower Centre: Girder being placed.

early stages of the bridge construction while the pedestals were being placed. A slide occurred on the southern cut bank which totalled 65,000 cubic yards and completely carried away two of the pedestal excavations, which fortunately had not been poured with concrete at the time. This involved a revision of the plans for that section of the bridge, and careful work on the site itself in sloping off the bank so as to prevent a recurrence of the sliding. These banks, which are common throughout the dry section of British Columbia, are composed of a sort of volcanic ash with strata of indurated clay. They are quite stable as long as they are kept dry but melt away in a most surprising fashion in the presence of even a very small amount of flowing water.

The substructure and excavation for the bridge was carried out by the Northern Construction Company, contractors on the line, and the steel was fabricated and erected by the Canadian Bridge Company, of Walkerville, Ontario. The great height of this viaduct precluding the use of any false work, special construction methods had to be worked out and special equipment provided. In general, the method adopted was as follows.

After erection of the first tower, a cantilever bracket was attached on which a temporary 70 foot plate girder section, with track for the derrick car, was then laid. From this the first half of the next tower was erected, temporary steel struts being placed between this and the tower already completed. The next step was the removal of the temporary 70 foot girder section, and its replacement by the permanent 100 foot girder span connecting the two towers. The cantilever bracket was then moved ahead, attached to the half tower just erected with the 70 foot girder on it, and from this the tower was completed, the process being completed as before, by the removal of the temporary girder, its replacement by the permanent 80 foot girder section, and the removal of the steel struts placed to take the construction stresses.

A special derrick car was brought in for this work, of a size and weight capable of handling the girder sections complete, consisting of the two main girders with internal cross-bracing complete. Details of the construction method are well shown in some of the illustrations herewith.

A similar bridge to the one just described, but shorter has been fabricated by the Canadian Bridge Company for the crossing of Cottonwood Canyon, and it is expected that erection of this will be a part of the programme for this year's work.

Contract for Queenston-Chippawa Intake

The Hydro-electric Power Commission of Ontario has awarded the contract for constructing the intake and ship channel in connection with the Chippawa-Queenston power development to the firm of Tomlinson, Macaw & Macdonald of Winnipeg. The price is in the neighborhood of half a million dollars. There were twelve tenderers.

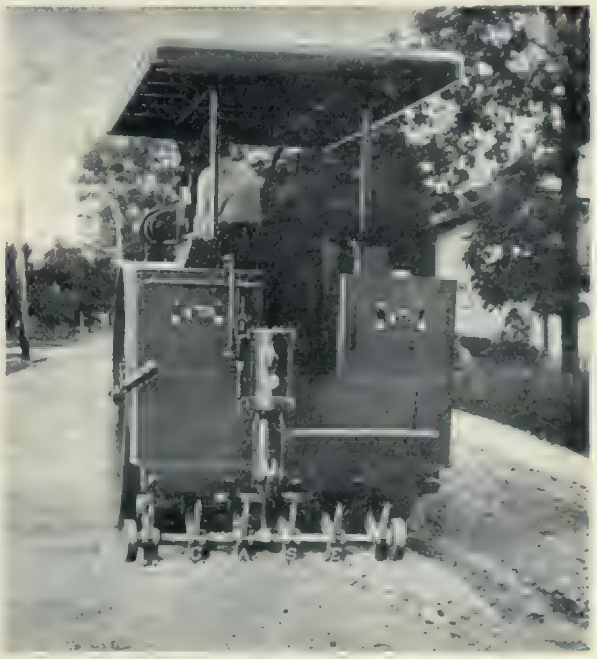
The contract stipulates that the work must be completed by the first of December next. Altogether, about 250 men will be employed during the season, as well as three steam shovels and 50 teams. The work consists of rock and earth excavation, concrete cribwork, rip-rap and rock-filled cribs.

This contract is separate from the dredging and from the construction of the "finger" intake, which will not be done this year.

New Steam Scarifier

Among the new pieces of equipment to come upon the market this season, is a new steam scarifier to be attached to the Case Road Roller, which has just been announced by the J. I. Case Threshing Machine Co. of Toronto, Ont. The manufacturers of the new Case scarifier claim that it has several distinctive advantages and features that contribute to its general durability and efficiency. Some of the practical advantages of this roller and equipment are: The ample power of the roller to handle the scarifier, operating economy, ruggedness and dependability so essential to withstand the severe work often encountered, flexibility and easy control of outfit.

The scarifier is attached to the rear of the roller and the operator handles both. The additional weight of the complete attachment is about 1,850 pounds. A steam pressure cylinder is employed to raise and lower the teeth, which is under instant control of the operator, by manipulating a four way valve. The teeth are forced into the ground under a steam pressure of 4 tons and are held there by a steam cushion. The picks are quickly raised or lowered in passing over cross walks, manhole covers and other immovable obstacles.


The Case steam scarifier attached to a road roller

Six scarifier teeth of 1½ in. by 2½ in. section and 22 in. long are used. They are made of tool steel accurately forged and carefully tempered. The picks are adjustable for depth and gauge wheels prevent them from digging below the required depth in case the rear rolls drop into a hole in the road. The width of cut can be varied from 40 in. to 56 in. depending on the spacing of picks, or any of the picks desired can be removed.

The steam rollers with scarifier attachment have all steel gearing. Spring cushions in the differential gear assembly serve to absorb all sudden strain thrown on the gearing. This is an important feature in a roller used for this kind of work.

The Ontario Safety League has just issued its eighth annual report, covering the calendar year 1921.

New Type of House Construction—All Steel and Gypsum

An Incombustible Residence Comprising a Structural Steel Frame With Non-Bearing Gypsum Board Walls and Partitions on Simplex Steel Studs—Details of Cost

An interesting development in the house building field is the all steel and plaster house, the first example of which was recently completed on Nealon Ave., Toronto, by the Ontario Gypsum Co. This particular house was erected with the idea of developing an incombustible type of construction, for which purpose, of course, steel, Gypsum board and Gypsum plaster are admirably suitable. The details of construction of this unusual house are described as follows by the Ontario Gypsum Co.:—

Steel lumber has been used to some extent in various types of construction, but we believe our company was the first to utilize it on a dwelling from the cellar to the roof.

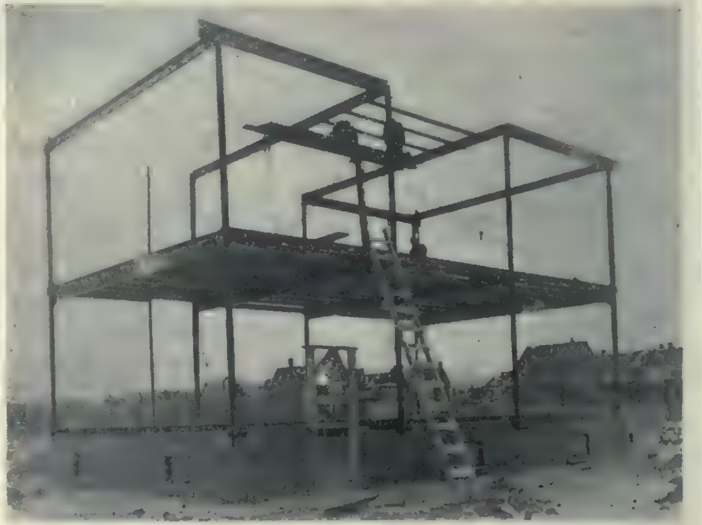
Our idea in constructing this house is to demonstrate beyond doubt that a house built of steel and gypsum could be constructed at a reasonable price and to convince the authorities interested that such a house would be ideal to live in on account of the insulating qualities of the gypsum, would be fireproof and would possess none of the disadvantages commonly associated with frame or brick houses.

The foundations are solid brick and carry a self-supporting steel framework

In the first place we were handicapped through our inability to secure in Canada what is commonly known as steel lumber. We had to do the next best thing and secure from the steel company standard size I-beams and channels which we utilized to the best advantage in the framing.

The corner posts were 4x4⅜ L, as were the stair well posts. The intermediate posts were 3x3x5/16 L. The joists were 9-in. steel I joists at 7.7 pounds. The supporting frame was made up of 6-in. and 9-in. channels, and the roof frame was made of 4-in. steel I-joists. Metal cross bridging was used in the floor construction.

It can be readily seen that framing of this heavy steel would be sufficient to carry probably four times the load considered necessary in house construction, and consequently on other dwellings of this character the steel cost could be reduced probably 40 per cent. by utilizing regular steel lumber instead of standard steel.



The first stage of construction of a steel and gypsum fire safe home is to lay the foundation and erect the light steel carrying members

The steel on this particular house, the size of which is 25x35 ft., cost erected $1176.26. The brick work and excavating, which includes the walls of the cellar which are all of brick, $585. The lot cost $1200; hardware, $55; lumber, $200; steel sash $193.55; furnace, $180; electrician, $90; plumber, $500; Simplex steel studding, $230. The concrete floor in the base-

Steel floor joists and roof members are then placed and the entire frame work is self-supporting ment, walk, etc., $250; painting, $130; tinsmithing, $55, etc.

This house cost us when complete $8782.65. In the city of Toronto at the present time when building costs are very high, this is considered a very reasonable price.

Naturally, the mechanics we had working on this job were handicapped to a considerable extent owing to the fact that they had never worked on such construction before. This resulted in a high labor cost on the dwelling which on future constructions of the same character could be to a large extent eliminated owing to the fact that we, ourselves, would have more experience and would know better how to direct our employees in the application of the material required.

Applying the gypsum board and the reinforcing wire on the roof cost 64 cents per yard. There was a considerable amount of labor entailed, and as we pointed out before, our method was entirely new to the men. Plastering the roof two coats to a thickness of 1¼ in. cost 42 cents a yard, and plastering the outside walls on top of the gypsum board with one coat of neat pulpstone hard-wall plaster sanded and one coat of Pozzo base pebbled into the first coat of hard-wall plaster cost 28 cents per yard. The applying of the Simplex studs, gypsum board and netting on the outside walls cost $1.10 per yard. Scaffolding on the outside walls 13 cents per yard. These are all labor costs. Labor costs per yard on the Nealon Avenue house might be interesting to study:

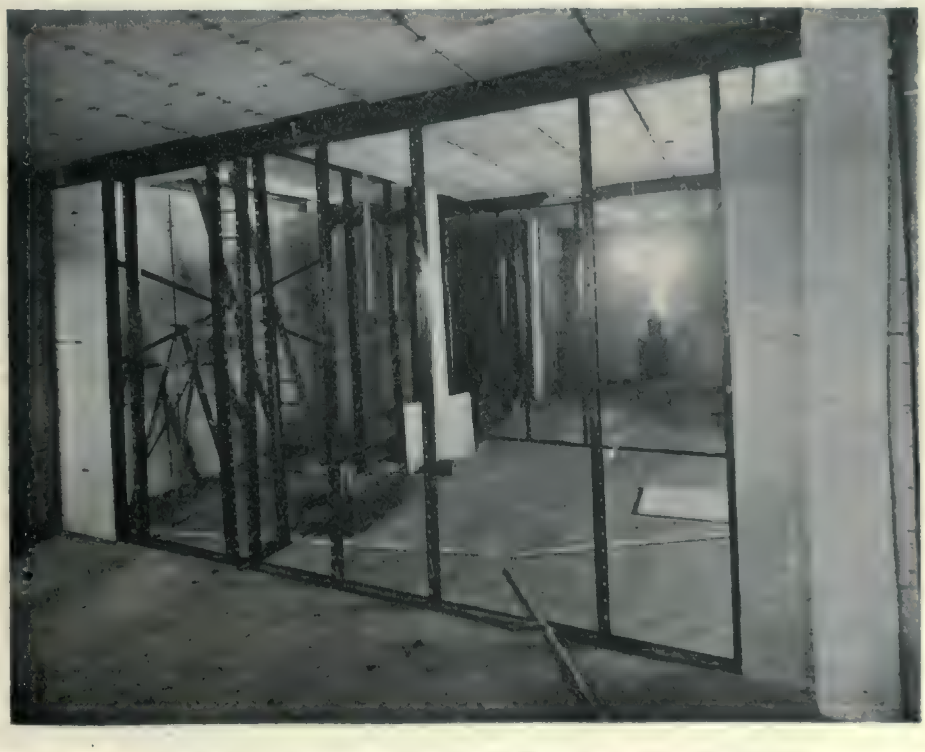
Net Labor Costs Per Yard

Fixing board and fence wire on roof	$ .64
Plastering two coats 1½ in. thick on roof ..	.42
Fixing Simplex studs, boards and chicken wire on outside walls	1.10
Plastering outside walls—one coat neat material, one coat Pozzo base	.28
Scaffolding outside walls	.13
Fixing ceiling runners and boards	.27
Fixing interior studs and boards	13.
Plastering interior base coat	.14
Plastering two coats on floor	.43
Fixing board and wire on floor	.22
Strapping floors	.16
Plastering between strapping	.25

We cannot possibly make it too emphatic when we say that these costs do not truly represent what could be done on buildings of this character when the mechanics became more used to it.

Stucco has been applied over gypsum plasterboard producing a lasting finish

The utilizing of Simplex steel on the outside wall is an innovation, and we are positive that this will prove to be a decided success. When the gypsum board is applied on both sides of the studding and a heavy coat of exterior stucco put on the outside plastered with hard-wall plaster, it forms a wall, which, in our opinion, is unequaled. It is very strong.



The interior partition construction. Special steel studs are used which accommodate stock size plaster board.

rigid and incombustible. There should be absolutely no expansion or contraction, and as a matter of fact we examined the wall on January 31, 1922, and could not find a hair crack in the whole building either on the outside or on the inside.

The floors were constructed of gypsum board laid down on top of the steel; wood sleepers were put on and plaster put in between the sleepers. The finish will be hardwood flooring nailed to the sleepers.

The roof was built up of gypsum board on top of the steel, heavy poultry netting on top of the gypsum board and then 1¼ in. of hardwall plaster put on in two coats, troweled smooth, and asphalt plate shingles laid on top of this.

All the partitions were constructed of Simplex steel studding, gypsum board and hardwall plaster.

Another innovation in this house was the elimination of lime mortar for finish. We used Gyproc finishing plaster and achieved beautiful results. The consequence is that this house can be decorated immediately and the damp, cold wall commonly associated with lime mortar is done away with.

The photographs give a good idea of the construction both on the outside and on the inside.

The method of applying waterproof cement and magnesite stucco to gypsum board or gypsum blocks over exterior walls of buildings is in brief as follows:

First, apply a coat of gypsum mortar, which everyone knows will bond perfectly to either gypsum board or gypsum block. Then before the gypsum mortar has set apply a coat of waterproofing cement of magnesite stucco. Then after this coat of cement or stucco is thoroughly hardened, apply finishing coat in any manner desired. By this method both a chemical and mechanical bond is secured and we have numerous practical demonstrations in Canada where this stucco has gone through three Canadian winters now without any sign of deterioration.

This method of applying exterior stucco is protected by United States Patent No. 1,355,667, issued to Mr. Robt. E. Haire, general manager, The Ontario Gypsum Co., Ltd., October 12, 1920. "Wall Construction and Processes."

Is Plaster Always Properly Sanded?

A Reader Claims That the Frequent Use of Poor Sand by Irresponsible Contractors is Prejudicial to the Man Who is Trying to Give His Customers a Square Deal

The use of "sand" that is not sand at all, or the use of too much sand in mixing wall plaster, seems to be a weakness in the building industry that is not being remedied in keeping with modern ideas of permanence and excellence in construction work. The plumber and the electrician must use standard equipment that has been properly inspected in its manufacture and the work is inspected after it is completed, but the plasterer seems to be a free lance. If he has no reputation, he has nothing to lose, and if he has a reputation and is anxious to maintain it, he finds himself in competition with others whose main idea seems to be to give a cheap job at the lowest possible price.

The matter is again brought to our attention by an interesting letter from one of our readers, who is intimately associated with the plastering industry. He writes in defence of the members of the plastering industry who are endeavoring to give their customers a square deal and this is what he says:

"Why is it that a plastering contractor in the east end of Toronto, for instance, can dig out a very inferior grade of sand, composed mainly of clay loam, from the cellar of a house that is being excavated, mix it up with some lump lime which is probably air slacked, put it on the wall of a house that is selling for $7,000.00 or $8,000.00, get his money and go on to another job and do the same thing? Why can't a plumber, or an electrician, or a concrete man do practically the same thing on their end of the work? Why is it that nearly every plastering contractor in every community has a different price for plastering?

"Is it a fact that people are so uneducated and the authorities, general contractors, architects, etc., are so lax that they will stand for any kind of a wall in a building?

"We are not speaking of a large plastering contractor who does good work and who uses good material in the right way. We are talking of the small plastering contractor who works on speculative houses and other medium class jobs.

"There is a reason for this class of work and also a remedy. The electrician and the plumber cannot possibly do inferior work on a dwelling, because the city authorities and other interested parties inspect the job too closely and make certain that it is all right before the work is approved. This is a protection for the buyer. But the plasterer can go along in the same old way, put any kind of mud he likes on the wall and get away with it. There is no one to say whether he is right or wrong and nobody seems to care

"This is not a square deal either to the contractor or to the owner, and will certainly be detrimental to the building trade in general before very long.

"We have made repeated efforts to interest the architectural fraternity, but have not been successful. We think that plastering should have rigid inspection. We believe there should be a campaign carried on to educate the people to expect and demand good walls in their homes. There is no doubt whatever that this cheap kind of work does all kinds of harm to the plastering trade in general and that the better class of plastering contractors are fully aware of this and would do something to stop it if they could."

We should be very glad to have the opinions of plasterers themselves, or any other of our readers who are interested in this matter.

The National Lime Association have issued a folder calling attention to the bulletins of the construction department of that organization.

Revision of the Cost Estimates of the Johnson St. Bridge, Victoria

New Figures Indicate that the Structure Will Cost at Least 15% More Than the Original Estimate— Increased Cost is a Reflection on Day Labor Methods

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

A revision of the estimated cost of the Johnson St. bridge project in Victoria, B. C., has just been made public by the city council and the engineering department which has created a feeling of consternation since it shows an increase of over 15% above the original estimates making up the total. As originally estimated, the project was to cost $720,000 of which the provincial government contributed $200,000 and the Canadian Pacific Railway $100,000, leaving $420,000 to be provided by the city, which was arranged for by the passage of a by-law authorizing the floating of bonds to the required amount. Statements of an optimistic nature have been issued from time to time by the engineering department to the effect that the work in hand was in all cases costing less than the estimates and one or two small increases in minor items were satisfactorily explained, so that the public were taken by surprise when the announcement was made that the bridge could not be completed for the amount subscribed by the various parties to the construction and would cost at least $110,000 more. Efforts have been made without success to obtain increases in the contributions of the provincial government and the Canadian Pacific Railway Co., and an application to the provincial government for an order-in-council authorizing the increase of the issue under the original by-law to the extent required was also refused, so that the only alternative remaining is to place a supplementary by-law before the people, which will be done this month.

The original and the present estimate of costs as detailed by the engineering department are as follows :—

	First Estimates	New Estimate	Increase	Decrease
Substructure	$170,950	$239,086	40%	
Superstructure	425,120	481,000	40%	
Approaches	36,040	34,000		5%
Engineering & Legal	30,000	40,656	36%	
Land	40,000	25,000		37%
Contingencies	17,890	10,258		42%
Totals	$720,000	$830,000	15%	

Of the items marked for decrease that of "approaches" has not yet been put in hand and is entirely a matter of judgment, while the item for "contingencies" has the note appended that the amount of $10,258 has already been expended with the project still far from completion, so that it is quite probable that the original estimate of this item is probably nearer the correct figure.

This whole matter is of more than local interest owing to the commentary it offers on the practices followed by the city council in awarding the different portions of the work. In the first place it was decided that the employment of an experienced consulting engineer for the design and supervision of the project was an unnecessary expense and the responsibility of the whole work was placed on the shoulders of the city engineer. Gratuitous engineering service was accepted from the Strauss Bascule Bridge Company for making up the preliminary estimate of the weight of steel in the bridge, and this estimate was subsequently found to be far below the actual requirements. This fact, it is stated, with certain additional requirements of the bridge engineers of the Canadian Pacific Railway Company, accounted for the increased cost of the superstructure which amounts to $55,880, deducted from the contract and tender figures of the Canadian Bridge Company, contractor for the highway portion of the bridge and successful tenderer for the second or railway portion.

Canadian Bridge Co's derrick on the Johnson St., bridge Victoria, showing the 180 ft. boom assembling the main truss of the bascule span in the inclined position

Disadvantages of Handling Work by Day Labor

The substructure it is estimated will cost $68,136 more than the figure originally estimated by the engineering department in competition with the contractors tendering for the work. This estimate a-

Derrick with 90 ft. boom assembling steel

Setting main journals for bascule span

mounted to $170,950 and the lowest figure submitted by a contractor was in the neighborhood of $210,000. Instead, however, of regarding the department's figure merely as an estimate, the city council treated it as a tender and at once awarded the work to its own department to be done by day labour. This practice has been on the increase in certain western municipalities within recent years, based on the fallacy of "saving the contractor's profit" and in the case of Victoria was carried to the point of seriously considering the purchase of the steel for the bridge and erecting it by day labour under engineering department supervision.

The construction of the substructure has been very well handled by the department, which was, of course, under the disadvantage of having to purchase a great deal of equipment for the job, and was also under the necessity of building up its own experience to a large extent. A further complication has been the necessity of leaving portions of the east abutment and the trunnion pier for subsequent construction to avoid weakening the foundations of the existing bridge, which is still in use by the railway company. During the excavation for the trunnion pier a rather alarming accident occurred due to the crib sinking through a hard capping of indurated clay into a stratum of mud. This was caused by over-ballasting to a certain extent, and was corrected without much trouble and without serious injury to the crib, which at first gave the appearance of being wrecked. No other incidents of this kind occurred, and it seems probable that the over expenditure was due to a low estimate of unit costs of excavation and concreting, etc., rather than to any of the well-known chances of this type of construction.

Engineering Allowances Were Low

The item allowed for engineering and legal costs in the original estimate was $30,000 amounting to 4.2% of the total. This was certainly low, as the engineering alone of a project of this kind will rarely be less than 5%. This has been increased in the new estimate to $40,656 which is still only 4.9% of the new total and is expected to cover legal expenses as well, which have been rather heavy on this work, due to certain disputes over the land required for the approaches.

Of the original contingency fund of $17,890 it is stated that $10,258 has already been spent, and this latter amount has been included in the new estimate as the total contingency fund required. The contingency allowance was originally only 2½% of the then estimated total cost, and as this has already been expended to the extent of 60%, it would seem to be the part of prudence to include in the new estimate a sum which could be drawn upon for unforeseen expenditures. As the matter stands, however, it is assumed that all such contingencies have already been met, an assumption which is, to say the least, optimistic in view of the fact that a certain amount of sub-aqueous work remains to be done.

Expert Supervision Desirable

The conclusions to be drawn from the situation that has arisen are, of course, the same as have been so often emphasized, viz., the advisability, which amounts to a necessity, of having all such projects under the supervision of a consulting engineer who is thoroughly familiar with the particular class of work proposed. It need hardly be reiterated that this involves no discredit upon the official holding the appointment of city engineer, whose duties are so multifarious and varied that he can rarely take the position of having what is specifically called "expert" knowledge of special works of major magnitude. And the other conclusion is that it is a practical impossibility to beat the contractor at his own game. The contractor's profit is his fee for expert services, and includes, from the clients' standpoint, the rental of equipment and the use of his organization, which has been gathered with the express purpose of handling work in an economical manner. It is only in the rarest instances that it can be shown that this "profit" about which such a cry is made, is actually saved by departmental handling of work.

The Lightning Rod Act

The provisions of "The Lightning Rod Act", which became effective in Ontario on January 2, 1922, have been issued in booklet form by the Ontario Government. This act regulates the sale and installation of lightning rods and insists on their arrangement according to certain rules and regulations, which are also included in the booklet.

Street Railway Changes in Victoria

Extensive Track and Equipment Alterations Necessitated by the Change in the Rule of Road Which Became Effective at the Beginning of the Year

The change in the rule of the road in British Columbia, authorized by statute to take place throughout the province on the first day of January, 1922, involved a good deal more than appeared on the surface, particularly in those cities which are served by a street railway system. That these changes were accomplished without a single serious accident being reported, without any actual cessation of traffic, speaks volumes for the organization and resource of the street railway officials, and for their care in laying plans for the continued service to the public while necessary alternations were in progress.

Serving the coast cities and the lower Fraser Valley, the British Columbia Electric Railway Co. is by far the most important organization of its kind in the province, and indeed, with one or two minor exceptions, may be said to be the only operating company. Systems are maintained and operated in Vancouver, Victoria, New Westminister and North Vancouver, and interurban lines connect outside points with these cities. In the case of the Mainland system three routes are in operation between Vancouver and New Westminster, each of which furnishes transportation to a thickly populated district to and from either city. Lines are extended into the valley of the Fraser also, as far eastward as the city of Chilliwack, an important farming center, about seventy miles from Vancouver, and as far south as Steveston, which is an important center for the fishing industry and the site of a number of canneries.

Changing cross-overs from left-hand to right-hand operation on the B.C. Electric Railway Co., Victoria

Considerable Change Necessitated

The change from left-hand to right-hand operation affected practically every part of the equipment, and the opportunity was seized as far as the Victoria system was concerned to change the cars for one man operation at the same time. During the autumn of 1921 the company made its position on this latter point very clear both to the municipal authorities and to the provincial government, and showed that it was faced with the absolute necessity of introducing this modification if fares were to be kept to the six-cent mark fixed only a short time before. No serious opposition to the proposed alternation was encountered, and several new cars of the latest type for one man operation were ordered.

As traffic was not to be interrupted, the work of making the alterations required by this programme obviously would be a matter of time, and is even at this time not entirely complete. It was possible, however, to do a certain amount of the work in advance, particularly as regards the alterations to the street cars, twenty-three of which, representing 62% of the total, were ready for operation under the new conditions on January 1st. This in itself was quite an accomplishment, as the cars in question could only be withdrawn from service two or three at a time, and had to be returned to the tracks for operation under the old conditions temporarily. They were used by operating the left hand emergency doors for the time being, and were run into the shop just before the New Year and on the first of January itself, being a Sunday, for the final touches. Ten cars of a new type have been ordered, and several of these have already been delivered and are in operation. They are the latest type, designed for one man operation, and represent the changing ideal in transportation, being of a much smaller and lighter build than the cars which have been in use for a number of years. The past tendency has been towards heavy double-truck cars with a total capacity of between seventy and eighty passengers. The new cars, with a total capacity of about forty passengers are quite light, and are mounted on a single truck, which is however of a special design and is considerably longer than those used under the single truck cars which were in use before the heavy cars came in. All cars are now fitted with full pneumatic control operated by the driver-conductor, and interlocking mechanism is installed between the brakes and pneumatically operated doors, and between brakes and motor controls, the latter so arranged that should the driver for any reason leave his seat the brakes are automatically applied and the car brought to a standstill.

The change to right hand operation has necessitated a large number of track alterations also. One hundred and twelve switches are included in the Victoria track system, all of which required adjusting to the new conditions. A number of new cross-overs were also required, also considerable alteration to the underground wiring and switch system. All this work, together with alterations and repairs to the overhead wiring and trolley wire switches, is now practically complete. Paving repairs necessitated by the track work mentioned is in the hands of the city engineering department.

Construction Developments During the Month of April

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, April, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	10	$ 246,000	11	$ 692,000	....	....	....	....	21	$ 938,000
Churches	9	225,500	5	214,000	1	$ 12,000	....	....	15	451,500
Factories	14	1,711,500	6	145,000	1	40,000	1	$ 5,000	22	1,901,500
Garages	12	53,000	14	46,200	....	....	3	7,400	29	106,600
Hospitals	2	110,300	....	....	....	....	1	28,000	3	138,300
Hotels and Clubs	5	236,000	1	20,000	1	5,000	....	....	7	261,000
Office Buildings	8	177,900	1	10,000	....	....	1	10,000	10	197,900
Public Buildings	3	79,500	1	25,000	....	....	2	8,500	6	113,000
Residences	1601	7,778,200	382	2,028,900	46	160,700	45	218,900	2079	10,210,700
Schools	17	1,341,000	13	577,700	....	....	1	15,900	31	1,934,600
Stores	100	1,536,000	29	333,000	2	9,500	4	48,000	135	1,926,500
Theatres	....	....	1	4,000	....	....	....	....	1	4,000
Warehouses	3	120,500	7	115,000	....	....	3	21,000	13	256,500
Total Buildings	1784	$13,615,400	471	$4,210,800	51	$227,200	61	$362,700	2372	$18,440,100
Bridges	4	$ 12,100	4	$ 37,500	....	....	....	....	8	$ 49,600
Sewers and Watermains	15	146,800	1	3,000	....	....	....	....	16	149,800
Roads and Streets	18	1,045,500	7	416,800	....	....	3	100,000	28	1,562,300
General Engineering	20	3,090,900	....	....	1	12,500	....	....	21	3,103,400
Grand Total	1841	$17,910,700	483	$4,668,100	52	$239,700	64	$462,700	2445	$23,305,200

Construction Contracts Awarded in Western Canada, April, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	....	....	....	....	1	$ 2,000	....	....	1	$ 2,000
Churches	2	$ 81,000	4	$ 100,000	....	....	1	$ 1,500	7	132,500
Factories	6	1,221,500	5	48,200	....	....	2	5,200	13	1,274,900
Garages	1	2,700	1	20,000	1	15,000	1	5,000	4	42,700
Hospitals	1	575,800	1	119,200	....	....	....	....	2	695,000
Hotels and Clubs	5	40,400	2	25,000	....	....	....	....	7	65,400
Office Buildings	2	4,500	3	23,000	....	....	2	30,000	7	57,500
Public Buildings	3	35,300	1	6,000	....	....	....	....	4	41,300
Residences	161	691,800	60	202,000	32	100,100	93	327,600	346	1,321,500
Schools	....	....	1	3,000	24	758,800	7	714,000	32	1,475,800
Stores	16	121,100	11	49,700	5	36,500	10	45,400	42	252,700
Theatres	2	10,000	....	....	....	....	....	....	2	10,000
Warehouses	1	2,500	1	1,000	2	30,000	1	7,000	5	40,500
Total Buildings	200	$2,736,600	90	$ 597,100	65	$942,400	117	$1,135,700	472	$5,411,800
Bridges	2	$ 210,000	1	$ 40,000	....	....	2	$ 11,300	5	$ 261,300
Dams and Wharves	2	14,000	....	....	....	....	....	....	2	14,000
Sewers and Watermains	2	16,600	....	....	....	....	1	800	3	17,400
Roads and Streets	....	....	....	....	....	....	1	25,000	1	25,000
General Engineering	5	261,500	1	120,000	....	....	1	12,000	7	393,700
Grand Total	211	$3,238,700	92	$ 757,300	65	$942,400	122	$1,184,800	490	$6,123,200

Contemplated New Construction Work in Canada, April, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	10	$ 320,000	8	$ 419,000	....	....	3	$ 175,000	21	$ 914,000
Churches	22	728,000	8	1,115,000	5	$238,500	10	131,000	45	2,212,500
Factories	14	3,701,000	11	682,000	3	165,000	15	277,000	43	4,825,000
Garages	8	145,000	3	163,000	2	12,500	4	90,000	17	410,500
Hospitals	3	100,000	1	10,000	3	210,000	2	14,000	9	334,000
Hotels and Clubs	16	538,000	7	175,000	2	150,000	12	202,200	37	1,065,200
Office Buildings	6	466,000	2	38,000	2	230,000	4	182,500	14	916,500
Public Buildings	5	89,000	1	25,000	2	26,000	7	73,500	15	213,500
Residences	255	1,676,600	202	1,432,200	123	577,200	142	654,500	722	4,340,500
Schools	36	1,922,000	22	249,500	5	281,000	50	675,700	113	3,128,200
Stores	30	583,000	14	283,000	4	65,000	25	268,700	73	1,199,700
Theatres	1	250,000	1	60,000	2	45,000	4	55,000	8	410,000
Warehouses	1	10,000	....	....	3	30,000	6	1,276,000	10	1,316,000
Total Buildings	407	$10,528,600	280	$4,651,700	156	$2,030,200	284	$4,075,100	1127	$21,285,600
Bridges	6	$ 191,000	11	$ 197,000	....	....	3	$ 59,000	20	$ 447,000
Dams and Wharves	2	35,000	3	61,000	2	30,700	3	12,000	10	138,700
Sewers and Watermains	21	325,500	5	239,500	3	116,800	5	49,000	34	730,800
Roads and Streets	39	1,288,000	10	1,612,000	17	463,500	9	807,000	75	4,170,500
General Engineering	8	112,000	7	1,262,000	....	....	22	1,281,000	37	2,655,000
Grand Total	483	$12,480,100	316	$8,023,200	178	$2,641,200	326	$6,283,100	1303	$29,427,600

Proper Aggregate for Concrete Roads

General Requirements for Highway Work — Tests for Stone and Sand That Aid in the Selection of Suitable Material for Best Results

By DUFF A. ABRAMS
Professor in charge, Structural Laboratory, Lewis Institute, Chicago

Before American Road Builders' Association

The widespread use of concrete in road construction is one of the most remarkable developments in recent years. The severe service to which such concrete is subjected has given rise to much experimental work in an effort to determine the materials and methods of construction which give the best results.

The aggregate comprises about 80% to 85% of the volume of concrete; consequently, this type of material is of considerable interest to all who are engaged in concrete road construction. On account of the great weight and the consequent expense of shipping long distances, it is essential that aggregates near at hand be used if they are at all suitable. The preparation of proper specifications and methods of testing are somewhat complicated by the almost endless variety of materials available. The requirements to be met must be dictated to a certain degree by economic consideration and by local conditions. Many researches both in the field and in the laboratory have been carried out during the past few months, or are now under way, which throw much light on the proper requirements for aggregate for concrete roads.

General Requirements

Aggregate has been defined as follows: "Inert material which is mixed with portland cement and water to produce concrete; in general aggregate consists of sand, pebbles, gravel, crushed stone, or similar materials."

Aggregate for concrete road construction must be clean, structurally sound, and inert in the presence of cement and water; they must possess also a certain quality which we may term weathern-resistance. The division of aggregate into fine and coarse is largely arbitrary, but should be preserved as a means of securing uniformity of grading in successive batches of concrete. A wide variety in size and grading may be used with good results.

The fine aggregate is generally required to pass a ¼-in. sieve; in some instances certain requirements for smaller sizes are included. Mortar strength tests are generally required.

Aggregate Tests

Tests of concrete aggregate are made for two distinct purposes:

(1) To establish underlying principles, and

(2) To determine whether a given sample conforms to certain predetermined standards.

The two purposes in testing mark the distinction between research and inspection. The adequacy of the tests made in inspecting concrete aggregates is dependent upon the correctness of the principles established by research.

Tests of aggregates have been undergoing marked changes during the past few years. The earliest tests of coarse aggregate were adapted directly from those made on rocks for macadam roads. Experience has shown that the tests for hardness, toughness and cementation value are of little value in judging the quality of an aggregate for concrete.

It is unfortunate that standard specifications and tests for concrete aggregates have not thus far been generally adopted. The American Society for Testing Materials, the Bureau of Public Roads, and other organizations have done much toward standardization, but much remains to be done. In the absence of generally accepted standard tests, I can probably do no better than to describe the tests now made on aggregates at the Structural Materials Research Laboratory, Lewis Institute, Chicago.

Several thousand samples of aggregates from many sections of the United States, Canada, and Cuba have been subjected to test during the past seven years. Many samples were furnished by engineers or contractors from concrete road jobs; others were collected especially for research purposes. A considerable portion of our research work has been devoted to determining the underlying principles involved in the use of aggregates of different types in concrete road construction. The methods of the American Society for Testing Materials have been followed where such methods have been adopted. It should be noted, however, that in many instances the A. S. T. M. methods have only recently been published as tentative standards and consequently they have not come into general use.

Fine aggregates are subjected to the following tests:

(1) Sieve Analysis—Per cent coarser than sieves Nos. 100, 50, 30, 16, 8 and 4. (Follow A. S. T. M. tentative test for sieve analysis for aggregate for concrete, 1921.)

(2) Organic Impurities in Sand—Digest sample in 3% solution of sodium hydroxide, observe color after 24 hrs. (Follow A. S. T. M. tentative method of test for organic impurities in sands for concrete.)

(3) Silt—Loss of weight of 500-gram sample, due to washing in shallow pan and rejecting wash water. (Follow A. S. T. M. standard method for test for quantity of clay and silt in sand.)

(4) Mortar Strength—Compression tests of 2 in. by 4 in. mortar cylinders at ages of 7 and 28 days, using 1:3 mix by weight and by volume. Make parallel tests on 1:3 Standard sand and mortar. (Follow A. S. T. M. tentative test for compressive strength of portland cement mortars.)

(5) Unit Weight—Puddle into 1/10 cu. ft. cylindrical measure in 3 layers. (Follow A. S. T. M. standard method of test for unit weight of aggregate for concrete.)

Coarse aggregate are subjected to the following tests, so far as the quantity of materials permits:

Nos. 8, 4, ⅜ in., ¾ in.. and 1½ in. (Follow A. S. T. M. tentative standard.)

(7) Abrasion—Use Deval abrasion machine; follow A. S. T. M. Standard or Mattimore's method if aggregate furnishes pieces of proper size; otherwise use test as modified by Rea and Abrams.

(8) Unit Weight—Puddle with 1/5 to 1 cu. ft. cylindrical measure in 3 layers. (Follow A. S. T. M. method of test for unit weight of aggregate for concrete.)

(9) Concrete Strength—Compression tests of 6 in. by 12 in. concrete cylinders at ages of 7 and 28 days, using 1.4 mix with local concrete sand, graded up to No. 4 sieve. Make 5 cylinders on different days from separate batches, mixed by hand. (Follow A. S. T. M. tentative methods of making compression tests of concrete, 1921.)

(10) Wear of Concrete—Use 8 in. by 8 in. by 5 in. blocks; 1:4 mix; relative consistency 1:10; test at 28 days. Mold specimens in metal forms and finish by hand. Make 5 specimens. Test in Talbot-Jones rattler; 1,800 revolutions at 30 r.p.m.

Sieve Analysis of Aggregates (1 and 6)

The sieve analysis of aggregates is important, but it must be properly interpreted. The sieve analysis reveals the quality of the aggregate so far as size and grading of the particles are concerned, and these are important factors in producing good concrete for both strength and wearing resistance, as has been shown by many tests. All scientific methods of proportioning aggregate for concrete are based on the sieve analysis. The practice of mixing fine and coarse aggregates in fixed proportions without regard to size and grading should be discouraged. A number of researches have been published during the past two or three years which indicate methods of dealing with this problem by use of the sieve analysis of the aggregate. Elaboration of these methods is not within the scope of this paper.

Good concrete can be made from aggregate of almost any size and grading (if of good structural quality,) providing these characteristics are properly taken into account in designing the mix.

The following from the tentative specifications of the Joint Committee on Concrete and Reinforced Concrete, places the grading of fine aggregates on the proper basis:

Fine aggregate shall range in size from fine to coarse, preferably within the following limits:

Passing through No. 4 sieve—Not less than 95%.

Passing through No. 50 sieve—Not more than 30%.

It will be noted that the grading is not mandatory; if fine aggregate of other grading is used, the proportions of cement, coarse aggregate and water must be such as to give concrete of the desired quality.

There is a marked tendency now to go to larger sizes of coarse aggregate in concrete roads; a number of specifications now admit aggregate up to 3 in. or coarser; this tendency should be encouraged. The use of the coarsest pieces which are practicable improves the quality of the concrete and reduces crushing and screening costs.

In this connection it may be well to say a few words on the relation between laboratory sieves and the sizes of material produced by commercial plants, which use circular screens made of perforated steel plates. A little consideration will show, and the investigations of the Bureau of Public Roads[5] have proven that the size of aggregate produced by a commercial screen is determined by one or more of the following factors, which have no relations to the size of the opening:

(1) Thickness of plate.
(2) Wear on plate.
(3) Diameter of screen.
(4) Length of screen.
(5) Inclination of screen.
(6) Rate of rotation.
(7) Rate of feed.
(8) Wet or dry screening.

In other words, a sieve analysis under standardized conditions is necessary in any case to give the actual sizes of material produced.

The writer wishes to emphasize the advantages which would follow from the general adoption of the sieves recommended by the American Society for Testing Materials, for Sieve Analysis of Aggregate for Concrete (that is, Nos. 100, 50, 30, 16, 8, 4, ⅜ in., ¾ in., 1½ in., and 3 in. square openings) in all specifications for concrete roads and for laboratory use. They now have the backing of the Bureau of Standards, the Joint Committee on Concrete and Reinforced Concrete, as well as other influential organizations. These sieves are on a scientifically sound basis, in that the width of the clear openings of each sieve is exactly double that of the next smaller one, and the ratio of wire diameter to clear opening follows a definite law.

Organic Impurities in Sands (2)

Organic impurity in sand is objectionable, due to the fact that it either greatly retards or entirely prevents the setting and hardening of the cement. Such impurities generally result from carelessness in stripping the overburden from sand and gravel pits. The colorimetric test made by digesting a sample of the sand in a 3% solution of hydroxide, which originated in this laboratory, is becoming generally accepted as a satisfactory criterion for this purpose.

Silt in the Sand (3)

In usual concrete work a small percentage of silt in sand is not objectionable, so long as it does not contain organic impurities and providing an excess of mixing water is not used. In the wearing surface of concrete roads, however, silt is especially objectionable, since it is likely to be drawn to the surface in finishing, thus producing a weak and friable concrete, where concrete of the highest quality is needed. The quantity of silt should not be greater than 3% by weight. The use of sands of higher silt content should be permitted only when there is good reason to believe the following precautions will be taken:

(1) Reduction of the quantity of sand to a minimum.

(2) Reduction of the quantity of mixing water to a minimum.

(3) Surface worked as little as possible in finishing.

The quality of concrete will in any case be improved by following precautions (1) and (2).

Mortar Strength of Fine Aggregate (4)

Most specifications require tensile strength of 1:3 mortar briquets; however, the compression test is much to be preferred. The comparison with 1:3 standard sand mortar at 7 and 28 days gives valuable information, providing the test is properly interpreted. If three sands give mortar strengths of 70%, 100%, and 130% of standard Ottawa sand, it does not follow that concrete made from these sands will show the same strength-ratios. In fact, they will show about 90%, 100%, and 110%. The reason for this lies in the fact that in concrete the sand is only, say, one-third the total aggregate, hence differences in strength of concrete due to variations in sands may be expected to be only about one-third those found in sand mortars. Sands which fall below standard in mortar tests can be used with good results, providing the mixtures are modified accordingly.

In many instances confusion arises as to whether mixtures for mortar tests should be made by weight or by volume. It is the writer's belief that the volume method is more nearly correct, since batches are most frequently proportioned by volume. Sands of a calcareous nature or which are unusually fine are unduly penalized when proportioned by weight.

Unit Weight of Aggregate (5 and 8)

The unit weight of an aggregate is of value in arriving at the quantities of materials necessary for concrete of a given mixture, as in A. S. T. M. method of proportioning concrete for laboratory tests. The A. S. T. M. method of determining unit weight of aggregates gives a quantity of material closely equivalent to that required for a batch of concrete of ordinary mixtures.

In the case of blast furnace slags and aggregates of unusual types, the unit weight may furnish some indication of the nature of the material.

The old theory that heavy aggregates are better than light ones has little basis in fact.

Abrasion Tests of Coarse Aggregates (7)

The per cent. of wear (or the French Coefficient, which is 40 divided by the per cent. of wear) is generally specified for coarse aggregates for concrete roads. The test is made in accordance with the "Standard Method of Test for Abrasion of Road Material" of the American Society for Testing Materials, adopted in 1908. This test was originally used in France about 1878 by M. Deval, as a test for crushed rock for macadam roads; it was introduced in this country about 1893 by L. W. Page for the same purpose. Upon the advent of the concrete road the test came to be used as a criterion of the quality of coarse aggregates, for lack of any other method of measuring the abrasive resistance of the material. The test requires 50 pieces weighing 5,000 gm. (about 2½ in. to 3 in. in size), hence, in general, it cannot be made on the aggregate as used in concrete roads, due to the absence of large pieces. The test is meaningless when applied to rounded pebbles. These conditions have led to a number of modifications of the A. S. T. M. test.

In a recent series of investigations of the abrasive resistance and concrete-making properties of about 150 different samples of coarse aggregate, the writer used the four methods of making the abrasive test described in Table 1.

The results of these tests are given in Table 2. Only samples were included for which tests were made by all methods. The A. S. T. M. method gives the lowest per cent. of wear in each instance; the Mattimore method gave about double the A. S. T. M.; the Rea method about double the Mattimore; the Abrams method gave values which average about the same as the Mattimore method. The different methods do not give the same rating to the different types of coarse aggregate. The values for gravel by the A. S. T. M. method are absurdly low. It is difficult to draw any conclusions from these tests, except to suggest a grave doubt as to whether any of these tests has any significance when applied to aggregates for concrete roads.

Table I—Methods of Making Abrasion Tests of Coarse Aggregates

All Tests were made in the Deval Abrasion Machine

Method	Weight and Grading of Sample (square - mesh sieves)	Abrasive Charge 1⅞ in. Cast-Iron Balls	Total Revolutions	Remarks
A. S. T. M.*	5000 gm. 2½ to 3 in.	..	10,000	50 pieces.
Mattimore†	5000 gm. 2½ to 3 in.	..	10,000	Same as A.S.T.M. except cylinders provided with 1/16-in. slots which allow fine material to escape as produced.
Rea‡	2500 gm. ⅜ to ¾ in. 2500 gm. ¾ to 1½ in.	6	10,000	Use volume of 0.11 cu. ft. in case of materials of unusual weight.
Abrams	2000 gm. ⅜ to ¾ in. 2000 gm. ¾ to 1½ in.	10	2,000	Use volume of 0.09 cu. ft. in case of materials of unusual weight.

*Standard Method of Test for Abrasion of Road Materials, A.S.T.M. Standards, 1921, p. 710.

†Use of Slotted Cylinder for Abrasion Tests of Rocks, Report New York Commissioner of Highways, 1917; p. 52. Also Proceedings A. S. T. M., Part II., 1918, p. 426. See results of tests made by this method by F. H. Jackson, Proceedings A. S. T. M., Part II., 1920, p. 278.

‡Abrasion Test for Gravel Aggregate, General Specifications for Materials, Ohio State Highway Department, Columbus. Also *Concrete Highway Magazine*, June, 1918. Mr. Rea used screens with circular openings ½, 1, and 2 in. The wire cloth sieves, with square openings, used in our tests give approximately the same separation sizes as the circular screens.

The values in Tables 2 and 3 (which do not entirely parallel), show that the type and per cent. of wear of the aggregate has little influence on the compressive strength or wear of the concrete.

The gradual lowering of the requirements in specifications (that is, permitting aggregate of higher and higher per cent. of wear) during the past few years, is evidence that practical road builders have reached the same conclusions from experience that has been brought out by laboratory research.

Concrete Strength (9)

Testing coarse aggregate by means of compression tests of concrete is not necessary as a routine method of inspection, unless the aggregates present some un-

Table II—Abrasion Tests of Coarse Aggregates (See Table I for details of methods of making tests)

Machine operated at 30 to 33 r. p. m.

The per cent of wear was based on the weight of material finer than a No. 16 sieve, or which escaped through the 1/16-in. slots in Mattimore's method.

Method	Per Cent. of Wear Limestone (17)*	Trap (4)*	Granite (3)*	Sandstone (5)*	Slag (8)*	Pebbles (18)*	Grand Av.†
A. S. T. M.	4.8	2.2	1.9	5.0	8.7	0.9	3.9
Mattimore	12.6	4.7	3.8	6.9	17.8	2.6	8.1
Rea	21.0	7.4	18.3	29.5	13.7	10.0	16.6
Abrams	10.5	3.8	8.0	17.1	5.7	4.9	8.3
Ave.	12.2	4.5	8.0	14.6	11.5	4.6	9.2

*Number of different samples.

†Averages not weighted.

usual characteristics. Such tests furnish the best information for research purposes and should be encouraged. Concrete cylinders 6 in. by 12 in. in size should be used if aggregates do not exceed 2 in.; for larger aggregate, 8 in. by 16 in. (or larger) cylinders should be used. The methods recently published in tentative form by the A. S. T. M. should be followed in making such tests.

The data in table 3 are a portion of the results obtained in the series of tests mentioned above, in which comparisons were made between the results of tests on aggregates and wear and compression tests of concrete. The principal details of the tests are given in the notes which accompany the table. Only aggregates which could be screened and recombined to conform to the grading shown are included. These tests were made in the same investigation as the abrasion tests in table 2. It will be noted that table 2 contains a much smaller number of aggregates than table 3, due to inability to secure pieces of the sizes necessary for abrasion tests, according to the A. S. T. M. and Mattimore methods. The compression and wear tests were made at the age of 3 months, after curing for 14 days in a damp room and the remainder in air.

These tests show a surprisingly uniform compressive strength for concrete made of pebbles, crushed limestone, granite, trap, sandstone and slag. It should be noted that all coarse aggregates were of same grading, and that different batches were mixed as nearly as practicable to a uniform consistency. Failure to take into account the effect of differences in grading of aggregate and consistency of concrete in comparing the concrete-making properties of different types of aggregate have led earlier investigators to the erroneous conclusion that there was a wider variety in strength of concrete from aggregates of the same type than for aggregate of different types.

Compression tests made at 28 days after damp-room curing with specimens still damp will give values about 70 per cent. of those in table 3; 14 days in damp-room and 14 days in air, about 75 per cent. of values in table 3.

Wear Tests of Concrete (10)

The wear test of concrete by means of the Talbot-Jones rattler furnishes an excellent method for research purposes, but is not practical as a routine method of inspection. A ring of 10 separately molded blocks 8 in. square and 5 in. thick is placed in the rotating head of the machine, where the finished surfaces are subjected to the tumbling action of a 200-lb. charge of cast-iron balls for 1,800 revolutions, requiring about one hour.

The wear tests reported in table 3 were made by this method and show what may be expected of various types of aggregate when subjected to exceedingly heavy wear. It should be pointed out, however, that concrete pavements rarely exhibit such a degree of wear that the quality of the aggregate becomes an important factor, so long as it conforms to the primary requirements of a good material. The requirements of modern traffic emphasize the necessity for good concrete, rather than straining after highest types of aggregate. Good concrete can be produced from inferior aggregates by proper methods of proportioning, control of mixing water, and curing concrete under favorable conditions. The wearing resistance of a concrete road is much more dependent on the quality of the concrete than on the quality of the aggregate.

It should be stated that there is a well-defined relation between strength and wear of concrete; the factors which produce concrete of high strength produce low wear.

Sampling of Aggregates

Tests of aggregates are worthless and are likely to be entirely misleading unless the sampling is properly done. Particular care must be used in sampling under the following conditions:

(1) Sand, gravel, or slag in undeveloped pit.
(2) Coarse aggregate in cars or stock pile.
(3) Rock in native ledge.

The Tentative Methods of Sampling Stone, Slag, Gravel, Sand and Stone Block for Use as Highway Material of the A. S. T. M., published in 1921, should be followed wherever applicable.

In selecting samples for tests in the laboratory the method of quartering may be used, or, better yet, some form of sample splitter.

A very common mistake is to furnish samples to the laboratory which are too small for proper tests. Complete tests require about 50 lbs. of fine aggregate and 100 lbs. of coarse aggregate.

Table 3—Wear and Compression Tests of Concrete Made From Miscellaneous Coarse Aggregates

Wear tests of 8 by 8 by 5 in. concrete blocksa made in Talbot-Jones rattler.

Compression tests of 6 in. by 12 in. cylinders.

Mix 1:4 by volume of mixed aggregate; approximately same as 1:2:3 mix.

Relative consistency, 1.10; about the same as should be used in the construction of concrete roads to be finished by hand.

Hand-mixed concrete: One specimen to a batch.

Cement: A mixture of five brands of portland cement purchased in Chicago.

Sand from Elgin, Ill., graded 0 to No. 4, used as fine aggregate in all tests.

Each coarse aggregate was screened and recombined to the following grading; No. 4 to ⅜ in., 25%; ⅜ to ¾ in., 50%; ¾ to 1½ in., 25% by volume.

For each aggregate sample, the value for wear was the average of 10 tests, and for strength, 5 tests, made on five different days.

Specimens stored in damp condition 14 days then in air until tested at age of 3 months.

Kind	Coarse Aggregate				Concrete Tests* (3 months)	
	Number of Samples Tested	Unit Weight—lb. per cu. ft.	Apparent Specific Gravity	Absorption at 8 hrs.; per cent by weight	Comp. Strength—lb. per sq. in	Depth of Wear—inches
Pebbles	24	102	2.56	1 17	4880	0.51
Crushed limestone	26	91	2.59	1 14	4560	0.44
Crushed Granite	12	92	2.59	0 82	4850	0.34
Crushed Trap	6	95	2 85	0.12	4210	0.40
Crushed Sandstone	7	86	2.34	3.94	4470	0.45
Crushed Slag	13	88	2.34	2.20	4240	0.48
Crushed Flint	2	83	2.43	....	4850	0 46
Crushed Marble	1	96	2.69	0.39	4620	0 42
Crushed Lava Rock	1	90	2.62	2.50	5350	0.40
Crushed Tufa	1	47	1.27	27 50	1960	0.66
Crushed Fire Brick	1	70	1.92	4.55	5390	0.43
Cement Clinker	2	88	2.23	3.20	5160	0.37
Boiler Cinders	1	40	1.51	8.70	3000	0.85

*Strength tests were also made at ages of 7 and 28 days, and 1 year on many of the aggregates.

Field Tests of Aggregates

In prospecting for aggregate supplies, or in making preliminary examinations of aggregates at their source, or after delivery, valuable information can be obtained from tests made in the field with portable apparatus. Tests which are the most significant and which lend themselves readily to field use are sieve analysis and the test for organic impurities.

Certain state highway departments furnish their inspectors with a set of sieves, made up in semi-cylindrical form and nested in a metal can. An approximate sieve analysis of almost any aggregate which is likely to be encountered can be made by use of the No. 50, 16, 4, and ¾ in. sieves. The first three sieves will give an analysis of fine aggregate which is sufficiently accurate for all purposes and probably far more accurate than the sampling. The last two sieves will give sufficient data on size and grading of coarse aggregate; the maximum size can always be determined by visual inspection. A large number of trials made by the writer in the laboratory show that by making sieve analysis of a wide variety of aggregates with the four sieves and interpolating the values for intermediate sieves, curves could be platted which compared quite favorably with those secured from the sieve analyses of the same aggregates, using the complete set of sieves.

The colorimetric test for organic impurities can readily be made in the field by using a graduated prescription bottle, with a supply of sodium hydroxide in stick form, the pieces being made up in advance of such size as will give approximately a 3% solution.

An excellent idea of the quality of native rock can be obtained by examining outcroppings and exposed ledges and noting the effect of weathering.

The importance of care in sampling must not be overlooked even in field tests.

The foregoing remarks make apparent the need for further research and standardization of methods of dealing with concrete aggregates.

Field tests now under way by the Bureau of Public Roads and by the State Highway Departments of Illinois and Pennsylvania may be expected to give important results on the relative merits of different aggregates. The Bureau of Public Roads, a number of state highway departments, and other laboratories now have under way investigations of aggregates which have thrown light on the properties which must be met for good results.

No attempt has been made in this brief review to suggest a complete specification for aggregates for concrete roads; however, certain principles which should govern the selection and the use of aggregates are given.

There is a marked tendency to disregard minor features in specifying concrete materials and to base final conclusions on the quality of concrete produced.

The characteristics of the aggregates are only one of the many factors which enter into the making of good concrete. The best aggregates do not insure superior concrete, if the methods of proportioning, mixing, placing and curing are faulty. Good concrete roads can be built of inferior aggregates, if the other elements are handled in such a way as to get the best out of the concrete.

The Erection of Towers 410 Feet High with 150-Foot Cross-Arms

Due to the great expansion of radio work, in recent years, some very unusual and improved methods of erecting towers have been used. This has been noticed in the recent erection of the towers for the New York Radio Central Station at Rocky Point, L. I. Twelve towers have been erected and the plan calls for the erection of sixty more sometime in the future. There are to be twelve wings of six towers each, all connecting to a central radio centre. When completed, it will be the largest and most complete station in existence and will be able to communicate with all parts of the world.

The towers are square in plan, 410 feet high with a 150-ft., cross-arm on the top. The base of the tower is 60 feet square at the bottom, 70 feet high and 38 feet square at the top. The height of the base made it suitable for erection by an 80 ft. gin-pole composed of four 20 ft. sections of 10 in. gas pipe. Each of the four legs was supported by a guy wire, running back diagonally, until they could be joined together and become self-supporting.

The body of the tower was composed of 10 panels of 30 ft., and one of 40 ft. It is 38 feet square at the bottom and 10 ft. at the top. This part of the tower was erected by means of a floating gin-pole, the same 80 ft. section of gas pipe being used with special fittings being placed on both ends. In erecting the first six panels the tower legs were erected singly and the bracing in panels. In the upper five panels, where the steel was lighter two tower legs and a panel of bracing were erected at the same time. The heaviest piece in the body of the tower was 3,400 lbs., but the heaviest lift was 4,850 lbs.

The erection of the cross-arm was the most difficult problem and a very ingenious method was used. It was thought very inadvisable to put any eccentric loads on the tower and the erection of the cross-arm by the cantilever method would have been unsafe and very costly due to the height above ground and the top of the tower being only 10 feet square. The rigging devised to erect the cross-arm a two-boom guy derrick with the gin-pole acting as the mast. Each half of the cross-arm was assembled on the ground and connected to the booms on the top of the tower. Each half was then raised simultaneously off the ground and thus balanced each other. One was raised to its proper position and bolted so that its weight was still balancing the other half which was then raised into position. Each half of the cross-arm weighed 16,000 lbs.

The bracing used throughout consisted of rolled angle sections in place of the usual rod bracing of the previously constructed radio towers. The lower 250 ft. part was riveted and painted while the remaining 160 ft. height and the cross-arm were bolted and galvanized. All rivets were ¾ in. in diameter, the galvanized portion being bolted with sherardized bolts which were checked with a diamond point to lock them.

Moving a Steel Railway Tank Two Miles

40,000 Gal. Tank Carried on Two Flat Cars and Replaced on New Site Without Difficulty

The 40,000-gallon conical-bottom Horton tank at Resplendent, B.C., was moved recently a distance of two miles to Red Pass Junction by an unusual method which proved entirely successful. This was done on two steel flat cars.

The method used was as follows: The steel flat cars were first heavily loaded with ballast, and spotted out, one on each side of the tank, until the draw bars were just clear of the riser pipe. The tank was then jacked up about twenty inches, enough to allow the track to be connected under the riser pipe, and also to give sufficient clearance between the sills and the top of the rail.

Two timber bents were erected, one on each end of the flat cars, just inside the columns, and the whole structure was supported on these two bents which were tied together at the top with two 8" x 8" timbers, notched over the caps and bolted one on each side of the tank bottom. The weight was distributed on the bents by placing four short posts on top of the bents just back of the columns, the top ends of these posts wedging against the bottom of the tank. The bents were well sway braced in both directions, and were bolstered on the cars with a two-inch pin through the centre, in order that the cars might be free to swing when going around curves.

The cars were then coupled with chains and turnbuckles, one on each side of the riser pipe, the turnbuckles being used to adjust the chains going around curves. A floor of three-inch planks was laid in the bottom of the riser pipe, and about three and a half yards of gravel were deposited in the heating chamber to act as ballast. Four sets of rope falls were used for guy lines extending from the top of the columns to the sides of the flat cars, these were fastened about fifteen feet from the end of the cars, in order that they would guy the tank in both directions, and in consequence of this we did not experience the slightest difficulty in negotiating two six degree curves.

On reaching the destination, the cars were again spotted out directly over the new foundation, and the tank jacked down into place.

The actual time that the main line was occupied was two hours and forty minutes, and no delay was caused to trains. In addition to this, the tank showed no signs of being damaged in any manner.—By C. P. O'Connor in "The Water Tower."

Table Bay Harbour Development

Mr. W. J. Egan, Canadian Trade Commissioner, Cape Town, reports to the Department of Trade & Commerce, Ottawa, under date March 21, 1922, that during last year the Ministry of Railways and Harbours of the South African Government appointed a committee to inquire into and report upon present day facilities at Table Bay docks, improvements which should be effected therein, and schemes for development of the harbour. This committee sat during September last and reported to the minister on October 1. Arising from this report a number of statements have been made which affirmed that certain improvements and an extension of the docks had been decided on. In connection therewith, several inquiries have come to hand from Canadian firms, one by cable. The position at the moment of writing is that there is no announcement by the Government as to which scheme, if any, will be adopted, but by the time this report reaches Canada, it is safe to say that the scheme known as the "Modified Southern Scheme" will be adopted by the Government.

Details of the committee's report on the scheme and the report itself have been transmitted and are on file at the Department of Trade and Commerce, Ottawa (quoting file No. 20991); but the point to be brought home to the prospective exporters of supplies is that the estimated cost of the proposed works is £3,701,150 and it is believed that it will take ten years to complete the task. In the first years it is estimated that the expenditure should average £550,000 per annum, the balance in four years.

A summary of the work is as follows: Warehouse and plant requirements, £401,250; extension and breakwater, 1,300 feet, £650,000; constructional requirements, £1,320,000; modified Southern Scheme, £1,330,500; or a total estimated cost of £3,701,150.

The machinery and steel requirements seem the most likely items on which Canadian firms may seek orders.

It is anticipated that there will be very little reinforcing iron used in the cement work, as most of it will be in huge blocks. The supply of cement in another six to eight months' time will have to be in competition with local production in the Cape Province, as well as English and Continental supplies, which for several reasons are much lower in price than other sources of supply. There is also the possibility of a higher customs tariff on cement, as the local cement interests are making a strong plea for an increased tariff.

New Bridge Over the Hooghly to Cost £2,000,000 Sterling

Major H. A. Chisholm, Canadian Trade Commissioner to the Department of Trade and Commerce, Ottawa, in Calcutta, writes under date March 10, 1922, that a committee of engineers appointed by the Government of Bengal to advise as to the erection of a new bridge over the Hooghly river at Calcutta submitted a report on March 13 recommending that a bridge of the cantilever type be constructed at a cost of £2,000,000 sterling.

The report advises (1) that "in view of the serious condition of the existing floating bridge and the grave consequences which would result from its failure, no time be lost in providing a new bridge over the river Hooghly," and recommends (2) that "steps should be taken at once by the Government to obtain a specification and tenders for the bridge recommended by us, without waiting for a decision in regard to the financing of the bridge construction."

Canadian firms interested should communicate at once with the Canadian Trade Commissioner, Post Box No. 2003, Calcutta, and should in addition advise their London representatives or the Canadian Trade Commissioner in London, as copies of the tenders will probably be despatched to the office of the Indian High Commissioner in London.

Comparative Statement of Contracts Awarded in Canada

According to Geographical Divisions	Ontario	Quebec	Maritime	Western	Total
April, 1922	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1922	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

According to Classifications of Types	Residential	Business	Industrial	Engineering	Total
April, 1922	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April, 1919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1922	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1921	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1920	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4 months, 1919	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Structural Steel Inspection

How the Hydro-Electric Power Commission of Ontario Examines the Steel Used by Its Construction Department

From H. E. P. C. Bulletin

Inspection as ordinarily provided for in specifications is a form of insurance. Its object is to insure the performance of the specifications in all details so that the purchaser will receive that which the manufacturer contracted to deliver.

The inspection of structural steel with which this article is specially concerned may be classified into the inspection of—

(a) Materials;
(b) Workmanship;
(c) Dimensions;
(d) Erection;

Inspection of Materials

Inspection of materials covers all the processes of manufacture as well as inspection of the finished product. In all but exceptional cases it is sufficient in the inspection of steel for structural purposes to confine the inspection of the material to an examination of the finished product. This includes testing samples of the steel to determine if the chemical and physical properties are correct. In the surface examination of the steel defects such as slivers, cracks and blisters are noted and where they are of a serious nature, they are cause for the rejection of the pieces in which they occur.

Rusted surfaces are also examined and the inspector has to distinguish between surface rust, which can be removed with a wire brush, and pitting which is more serious, and which is usually a cause for discarding the material.

Inspection of Workmanship

Under this heading come the various operations carried out in the shop, the most important of which are shearing, punching, reaming, fitting and riveting. It is the duty of the inspector to see that these are properly carried out without damage to the steel and in accordance with the specifications.

There are some points about which the inspector has to be particularly alert. In shearing care should be taken to see that the distance from the centre of rivet holes to the edge of the plate is not less than the minimum distance required by the specifications. In punching, the centering of rivet holes should be taken to see that the drills are inserted at right angles to the axis of the member being drilled. In fitting all burrs should be removed from the edge of rivet holes and the pieces drawn together and bolted tightly with sufficient bolts to keep them in close contact while they are being riveted.

Careful attention should be given to the matching of the holes when two or more pieces are to be riveted together. If the matching of the holes is not good, it may be corrected, where the conditions will allow, by reaming the holes to a larger diameter and using a rivet of corresponding size.

In riveting the inspector must see that the rivets are tight and have properly formed concentric heads. Strict attention should be given to the dies and all worn dies should be discarded. Close watch should be kept on the compressor gauge to see that sufficient pressure is being supplied to the riveting machines.

There are other operations perhaps not quite so important as those we have already mentioned to which attention must be given. Among them are chipping, countersinking, grinding and milling.

Dimensions

The inspector is not only responsible for workmanship but it is his duty to see that the fabricated pieces conform to the drawings in every detail. The sizes of the sections comprising the member, the overall length, the spacing of the rivets and other dimensions have to be checked up. Particular attention is paid to the open holes for field connections and to all governing dimensions such as the height of brackets on columns and the distance from the end of a beam to the point where other beams frame in. In structural steel designing certain combinations of members recur frequently and the designs of these are usually standardized. These standards are different for each shop and thus it becomes necessary for an inspector to familiarize himself with the practice of each shop. These standards are usually available in blue print form from the drawing office.

Erection

The field inspector takes the fabricated steel and sees that it is erected to form the structure desired. Inspection of the assembly of the parts and the riveting, painting and other operations are part of his duties.

General Duties

The inspector has other duties arising directly out of his position as representative of the purchaser. He is usually required to follow the progress of the work and to assist in getting the different parts of the work in the order required in the field. He has also to keep track of all extras on the contract and to check the weight of all fabricated material purchased on a pound price basis. He has also to make progress reports on the job from week to week to his principals.

The Hydro-electric Power Commission of Ontario maintains an inspection staff in the laboratories department which is charged with the duty as outlined above. During last year this department inspected upwards of 11,000 tons of structural steel made up into buildings, bridges, transmission towers, penstocks and tanks.

Reinforced Concrete Skyscrapers

Tall buildings are numerous in our large cities. Often the only comment that they attract is one of protest against the obstructions encumbering sidewalks during their construction. After a building has been completed few persons not conversant with types of construction will see anything to distinguish it from another similar building. The fact that it may be an entirely different type of construction, introducing perhaps new things of great importance economically, seldom becomes common knowledge. Also seldom does it happen that the average citizen recognizes in a new type of skyscraper an established, accepted type of construction having advantages peculiar to that type alone.

It really required world war conditions to give the necessary impetus resulting in larger, more extensive adaptation of reinforced concrete for skeletons of tall structures. Designers thus forced through inability to obtain materials for the commoner types of construction, turned to concrete and at the same time found to their surprise that the cost of such structures was lower than they had previously believed. They learned that an actual saving resulted by comparison with usual types of so-called thoroughly fireproof construction, worthy of comparison with reinforced concrete.

They have found also that the time required to complete concrete buildings is somewhat less because the time element is considerably under control of the builder, since there is no necessity of waiting for the fabrication and shipment of structural shapes from distant shops. Materials for the most part can be obtained locally. This was of paramount importance during the war when economies in the use of transportation were imperative, and it still constitutes an important advantage of concrete construction. As a result hundreds of tall reinforced concrete buildings have sprung up during the last few years. In fact, in many localities the majority of structures, ordinarily classed as high buildings, and which have been in progress or were completed during the past season, are of reinforced concrete. In Minneapolis and St. Paul alone there are twenty-six buildings from ten to fourteen stories high with reinforced concrete structural frames. A hasty survey covering the entire country discloses that the number of reinforced concrete buildings over ten stories high, completed or under way, total around 300.

Architectural and engineering firms that have thoroughly enlisted the economics and advantages of the high reinforced concrete building have become specialized in this type of construction because of the possibilities thereby offered for professional advancement.

The question naturally arises as to why high concrete buildings required the impetus of war to force their advantages to the attention of architects and engineers. In addition to the mistaken idea that they were high in first cost, the impression prevailed that the lower story columns of high reinforced concrete structural frame buildings would have to be excessively large. Reduction of rentable floor area was added to the assumed higher cost of the buildings with natural acceptance of the resulting error that the entire building would be uneconomical. This impression, like others of its kind, became fixed through tacit acceptance without investigation, largely because of its frequent repetition. It is gratifying to know that the question is no longer viewed in this light—that knowledge of facts prevails and that unsupported statements cannot pass without challenge—Building Management.

New Plant for London Bridge Works

Ground is being broken next week for the new plant of the London Bridge Works, Limited, London, Ontario, which will be of modern steel fireproof construction throughout and equipped with the latest machinery for the production of steel structures of all kinds, chiefly bridges and buildings. This plant will be built on an improved factory site formerly owned by the Dominion Canners, Limited, located just off Dundas Road on the Grand Trunk Railway, consisting of about three acres, which will give ample space for the time being. In conjunction with the regular business of fabricating steel, an extensive warehouse will be built and equipped for the distribution of iron and steel products of all kinds, including steel plates, structural shapes, iron and steel bars, black and galvanized sheets, etc. The company feels that this plant and warehouse, when completed, about June first, will fill a long felt want in the London district and will render a much needed service to builders and contractors.

This company is incorporated under the Ontario Companies' Act with $100,000. capital and the officers and directors are as follows: President, T. J. Dillon, Welland, president of the Standard Steel Construction Company; vice-president, Geo. M. Reid, London, Ont.; directors: Mr. Philip Pocock, London, Ont.; Mr. E. S. Little, London, Ont.; Col. I. Leonard, London, Ont.; Mr. C. J. Madgett, Welland, Ont.; Mr. H. C. Baker, Welland, Ont. Mr. C. J. Madgett, formerly assistant general manager of the Standard Steel Construction Company of Welland will take up permanent residence in London and be the general manager.

Lightning Protection of Chimneys

If a factory chimney has an internal metal shaft part of the way up, this should be well grounded at the bottom, and should be connected at the top with the lightning conductor, so as to avoid flashes from the rod through the outer wall to the metal within.

Flagstaffs on buildings should be provided with their own conductors properly grounded, or be connected to the system of lightning conductors erected on the same building.

A New Steel Tank Bulletin

Technical Bulletin Number 10, just issued by the Horton Steel Works, Limited, is one of the most comprehensive bulletins from the standpoint of real information that has ever been issued to the petroleum industry. It was prepared under the personal supervision of Mr. George T. Horton, head of that organization.

The most striking thing about the bulletin is the extensive tabular data which it contains. Complete details of plate sizes and thicknesses, rivet diameters and pitches, and other parts, are given for more than fifty different tanks ranging in capacity from 500 to 100,000 barrels. Steel roof framing and supports for all ranges of sizes are shown in plan and elevation. Accessories for large tanks, such as the Horton truss stairway, steel ventilator and swing pipe with winch, are presented in clear drawings. The lap joint and butt strap joint tables which this bulletin contains will be most valuable to the engineer who wishes to check the efficiency of joints in the designs manufacturers submit to him.

Several pages of useful information for the oil men add to the value of the bulletin.

A Correction

In an article entitled "The Power Resources of the Prairies," which appeared on page 396 of our May 3 issue of the Contract Record, the first two lines of the fourth paragraph read "The province possesses available water power to the extent of 475,000 h.p. for maximum commercial development." This should have read "The province possesses available water power to the extent of 475,000 h.p. at ordinary minimum flow and 1,138,000 h.p. for maximum commercial development."

Editor-Manager

We can place a high-class Editor-Manager who has a knowledge of building. Apply by letter. Confidential.

Contract Record
and Engineering Review

Hugh C. MacLean Publications Limited, Toronto

The National Builders' Supply, have opened an agency in Ottawa at 62 Bank St., for the sale of the well-known Laprairie Quebec Brick. They are optimistic of the building prospects of Ottawa and surrounding district.

The A. B. Ormsby Co., Ltd., Toronto, are distributing a folder entitled "Some of the Big Things We Do." It is well illustrated, showing a number of the actual installations recently made by this company.

Britannia Mining Co. to Spend $800,000

New Steel Concentrator Building, Replacing Structure Destroyed by Fire, is Being Erected at Britannia Beach, B.C.—Townsite With 100 Houses is Under Way

When the new steel concentrator building for the Britannia Mining Company, at Britannia Beach, B. C., is completed next fall, the expectations of the management of the company is that the mine output will be increased to more than 2,500 tons of copper concentrates per day. The new concentrator is to replace the wooden structure destroyed by fire a year ago. It is estimated to cost $800,000. The building is designed in the form of a number of benches on the mountainside and the work of clearing the site, grading the benches and preparing the foundation at each step is now practically completed. The super-structure is to be of steel, and much of the steel for the framework has arrived at Britannia Beach. The Canadian Northwest Steel Co. of Vancouver, has the contract for this portion of the work. Heavy rock work had to be done in "benching off" the foundation, the rock being blasted away with heavy charges. Streams of water from the pipe lines of the company's power plant were played upon the foundation floating all debris down the steep mountain side.

In anticipation of the restored plant being ready for operation, the mining company is busy with very large development on the mine, which is situated three miles further up the mountain. This is to prepare for the increased tonnage it is intended to take care of with the new concentrator. The capacity of the old plant was only 1,000 tons of concentrates per day.

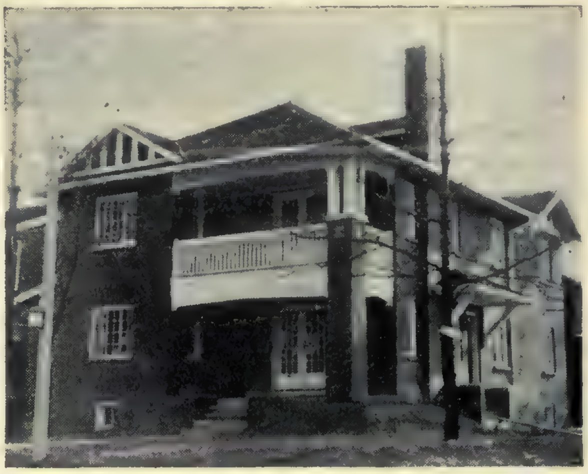
Another enterprise of considerable magnitude, now being carried on in connection with the work of restoring to activity the largest copper mine in the British Empire is the rebuilding of the town at Britannia Beach just below the concentrator. This town, which housed the employees at the plant, was wiped out by the floods of October 29th last, when nearly all of its 132 houses were either crushed by the avalanche of debris brought down by the flood, or else swept into the waters of Howe Sound. Work is now under way with a force of 400 men clearing the wreakage and preparing the new townsite which is being laid out on a plateau just above the old location at the beach. Something like 100 new modern houses will be built on the new site, and it is expected to increase that number to house the large number of men who will be required in the new plant.

Very high church spires and towers must be protected by two or more conductors.

The Contract Record's

Weekly House Suggestion No. 19

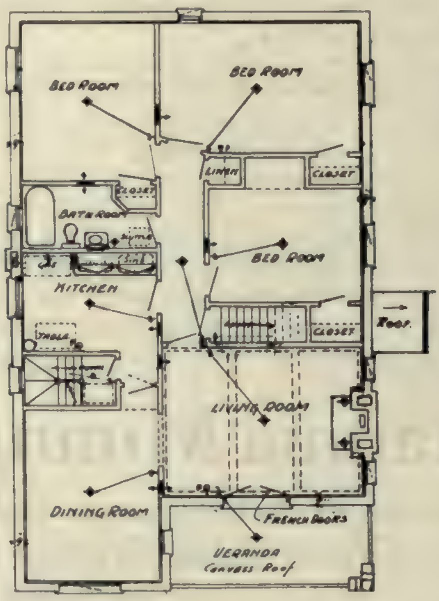
The accompanying photograph and floor plans illustrate an interesting and well planned residence of the duplex type just completed at the corner of Grassmere Road and Windermere Avenue, Toronto. Each floor is complete with dining room, living room, three bedrooms and bathroom, and is completely separated from the other, it being impossible to gain access from one floor to the other without going outside. The general construction is of red pressed brick, with stone trim; windows, doors, verandah railings and posts, waste pipes, etc. being finished in white enamel. The windows are all of the steel casement type.

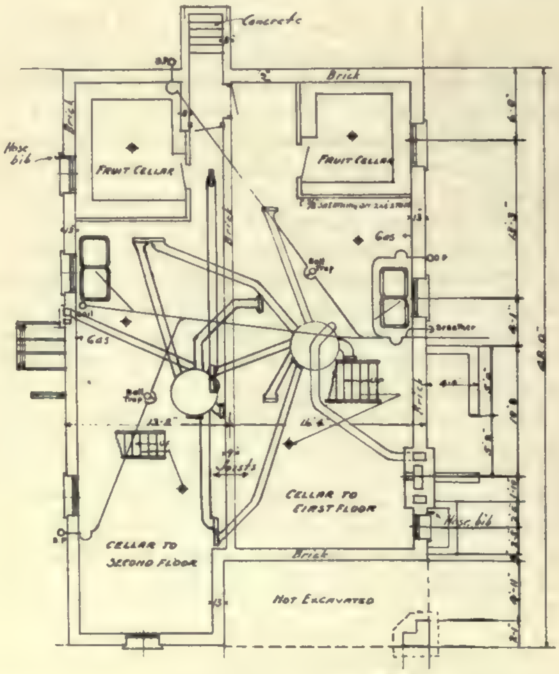


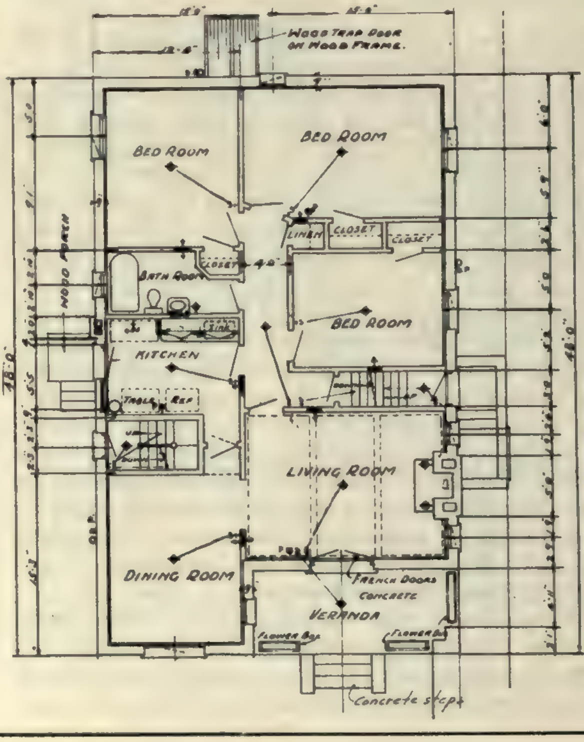
The layout, room sizes and equipment of both floors are identical, oak flooring and trim being used throughout with the exception of the bathrooms, which are finished in tile. The main entrance to the ground floor is directly on the living room, through double French doors. This room has a beamed ceiling and handsome brick mantel finished in oak. The balance of the rooms are all conveniently located off a short hallway and occupy every available foot of floor space.

The basement layout, plan of which is also reproduced herewith, is particularly interesting, and is divided by a through brick wall into two complete sections, each equipped with separate heating plant, which is of the hot air type, and coal storage space, fruit cellar, laundry space, etc.

Messrs. N. A. Armstrong Co. Ltd., industrial engineers & architects, of Toronto, were the designers of this house.







Mainly Constructional

East and West—From Coast to Coast

It is stated that the directors of the Dominion Alloy Steel Corporation have revised the plans for their huge new steel plant at Sarnia, to provide for a $5,000,000 instead of a $3,000,000 structure.

The Canada Crushed Stone Corporation, of Dundas, Ont., lost heavily in a fire which destroyed their screen house and much valuable machinery and equipment. The total loss was estimated at $350,000.

Kitchener, Ont., held a fire prevention and general clean-up week, from April 30 to May 6. The fire department and board of health co-operated in an earnest effort to rid the city of every possible fire and health menace.

New Brunswick legislature during its recent session passed an act increasing the provincial highway tax from twenty-five to forty cents on each $100 of the property assessment in the rural districts. Hon. P. J. Veniot said the increase, which would not become effective until 1923, would yield an additional $93,000 for road purposes.

The value of building permits issued at Toronto during the month of April shows a favorable increase over the total for the same month of 1921, the figures being $3,555,325 and $2,617,269 respectively. The bulk of last month's large figure was made up by residence permits, these totalling 532.

The town of Port Credit, Ont., has passed a building by-law which will bring all buildings and structures under the supervision and inspection of a municipally appointed building inspector. This action is part of the general town improvement and beautification policy being undertaken. Plans for the town's waterworks system have been completed and tenders will be called for the first section as soon as the plans have been approved by the Provincial Board of Health. It is estimated that this first section will cost $110,000.

In spite of the decision recently arrived at by the Arbitration Committee on bricklayers' wages, in the Toronto district, that 92½ cents an hour was a fair wage, the men have refused to abide by this award and are holding out for the $1.00 rate.

The convention of the Canadian Good Roads Association will be advanced one day in order to have it run in with the provincial meeting of the Engineering Institute of Canada, which will be held on June 16 and 17. The revised dates of the Good Roads meeting, therefore, are June 12, 13, 14 and 15.

A recent report states that the Cast Stone Block & Machine Co., of Windsor, Ont., are going into the building supply business and will carry a complete line of materials. They are desirous of obtaining prices on all kinds of materials and supplies.

Sir Charles Wright, London, England, a director of the steel firm of Baldwin's Limited, and also a director of Baldwin's Canadian Steel Corporation, was in Toronto recently, making an inspection of the Canadian Company's plant on Ashbridges' Bay and investigating business conditions generally in this country.

A new firm, the General Fibre Board Syndicate, 119 King St., London, Ont., has leased the old car barns in this city and will install machinery and equipment for the manufacture of fibre board for building purposes.

Reorganization of the Provincial Highway Board of Nova Scotia includes the appointment of Mr. A. S. MacMillan as chairman, succeeding W. G. Clarke who resigned last December. Messrs. W. A. Hendry, C. E., and R. W. McColough, C. E., are the other members of the new board, succeeding Messrs. Walter Crowe, Percy Black and James K. Kelleher. The number of divisions in the province has been reduced from ten to seven, dispensing with the services of three district engineers and their assistants. The Board has just brought in its 1921 report, a 421-page volume on road construction activities during the past year.

Personal

Mr. Jas. Thompson, architect, formerly of 43 Victoria Street, Toronto, and later with the Military Hospital branch of the Public Works Department, Ottawa, announces that he is resuming practice in Toronto, with offices at 59 Yonge Street.

Mr. C. H. R. Fuller, city engineer of Chatham, Ont., recently took over the additional role of city manager, under the new system of municipal government. His new position gives Mr. Fuller general supervision over all civic departments, with entire control of the city's policy as adopted by the city council.

Mr. J. B. Helme, a graduate in architecture from the Faculty of Applied Science and Engineering, University of Toronto, has been awarded a provincial scholarship in town planning, which provides for travel and study in France on the subject of "Town and Regional Planning and Housing." Mr. Helme is from Smith Falls, Ont., and entered the university in 1916 and was overseas for two years.

Messrs. Barott & Blackader, architects, of Montreal, have moved their offices from 10 Cathcart St., to the Canada Cement Bldg.

Messrs. Shorey & Ritchie, architects, of Montreal, have taken up new offices at 360 Beaver Hall Sq.

Mr. H. A. Terrault has been promoted to the position of director of public works of the city of Montreal, on recommendation of the Executive Committee. He was formerly employed as superintendent of the aqueduct department.

Mr. H. P. Borden, consulting engineer, recently opened an office in the Hope Chambers, Ottawa, and will specialize in bridges and steel and reinforced concrete structures. Mr. Borden is a graduate of McGill University and is a well known figure in engineering circles in Eastern Canada. Immediately after graduating in 1902, he was employed by the C. P. R., in the Bridge Department, following which he occupied the position of assistant chief engineer of the Locomotive & Machine Co. of Montreal. From 1906 to 1918, Mr. Borden was employed in different engineering capacities on the construction of the Quebec Bridge, in 1916 being appointed to the Board of Engineers supervising this work. During the years 1919-1921 he was employed by the Dominion government as consulting engineer.

Obituary

Mr. Michael Shields, well known in the marble and tile business at Ottawa, died in that city recently at the age of 69 years. Deceased had been a life-long resident of Ottawa.

Mr. Geo. Blanchard, architect, has recently opened an office in the Whalen Building, Port Arthur, Ontario. Mr. Blanchard was formerly with C. D. Howe & Co., consulting engineers, of Port Arthur, for a number of years, and is a member of the Ontario Association of Architects.

CONSTRUCTIONAL ACTIVITY

Period of May 3 to May 9, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Burlington, Ont.
Tenders will be called shortly for construction of pavement on Brant St., to cost $50,000 for Town Council. Mr. Sykes, clerk, Municipal Bldg.

Chatham, Ont.
L. A. Pardo, Kent County Road Sup't., Harrison Hall, Chatham, will receive tenders until May 17th for construction of concrete pavement. Plans with W. G. McGeorge, Engr., Queen St., Chatham.

L. A. Pardo, Harrison Hall, Chatham, Kent County Road Sup't., will receive tenders for construction of 1¾ miles of concrete pavement. Plans with W. G. McGeorge, Queen St., Chatham.

Dartmouth, N. S.
Town Council contemplate construction of sewer and a 6" watermain at cost of $10,000 on Old Ferry Rd. from Pleasant St. to Portland St. A. Elliott, clerk.

Town Council contemplate construction of sewer costing $11,000 on Rodney Rd. from Hastings Drive to Johnston Ave. A. Elliott, clerk.

Dresden, Ont.
J. T. Bridgewater, Town Clerk, will receive tenders until May 16th for construction of 18,500 sq. yds. concrete pavement. Plans with W. G. McGeorge, Engr., Queen St., Chatham, Ont.

Dungannon, Ont.
W. A. Wilson, Lucknow, Ont., clerk Wawanosh West Twp. Council, has plans and will receive tenders until May 24th for construction of overflow drain.

Fredericton, N. B.
B. M. Hill, Chief Engr. Dep't. Pub. Works, Prov. Gov't., has plans and will receive tenders until May 16th for construction of gravel roads in several sections of the Province.

Grand Mere, Que.
Plans are being prepared for sewer to cost $35,000 for City. N. Carson, Engr.

Plans are being prepared for macadam or concrete pavement to cost $25,000 for City Council. N. Carson, Engr.

Grimsby, Ont.
Town Council plan extending intake pipes from waterworks into Lake Ontario. W. T. Randall, secy.-treas.

Kenilworth, Ont.
Albert Hellyer, Kenilworth, clerk. Arthur Twp. Council, will receive tenders until May 16th for supplying drain tile, F.O.B. Kenilworth. Marked cheque for 10% of tender required.

Longueuil, Que.
A. St. Marie, Engr., will receive tenders until May 15th for supply of asphalt, sand, cement and drains.

Mitchell, Ont.
Town Council contemplate road improvements on Huron Rd., St. Andrews, St. Davids, Wellington and Quebec Sts. Wm. Ryan, clerk.

Montreal, Que.
City Council plan construction of pavement on Berri St. from Champ de Mars to Commissioners St., at cost of $40,807 and from Champ de Mars to Craig St., 15,270. S. Fortin, Engr.

Parrsboro, N. S.
Town Council contemplate extending Stanley St. to King St. H. F. Smith, clerk.

St. Thomas, Ont.
W. C. Miller, Engr., will prepare plans and estimates for pavements petitioned for on Miller and Erie Sts.

Plans are being prepared for sanitary sewers to be constructed on Hiawatha St. and Fourth Ave. for City. W. C. Miller, Engr.

Sault Ste Marie, Ont.
R. G. Campbell, City Clerk, will receive separate tenders until May 15th for various sizes tile and reinforced concrete pipe required for sewers. Plans with City Engr. L. R. Brown.

Simcoe, Ont.
G. R. Marston, Engr., Simcoe, has plans and will receive alternative bids until May 13th for construction of concrete or Tarvia macadam roadway to cost $60,000 from Simcoe northerly for Norfolk County Council.

Smith's Falls, Ont.
Construction of filter plant is contemplated by Town Council. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Thorold, Ont.
Town Clerk will receive tenders until May 13th for construction of sewer. Plans with F. N. Rutherford, Engr., 24 Queen St., St. Catharines.

Three Rivers, Que.
City Council plan construction of macadam pavements on Bonaventure, Royal, Laviolette, St. Maurice and St. Marie Sts., Chs. Gelinas, Engr.

Tilbury, Ont.
Plans will be prepared for concrete pavement to cost $25,000 on Young St. W. A. Hutton, Town Clerk.

Truro, N. S.
Town Council plan construction of pavement on Forrester St. J. G. W. Campbell, Engr.

Wadena, Sask.
H. S. Carpenter, Deputy Min. Dep't. of Highways, Regina, will receive tenders until May 23rd for roadwork. Plans with Dep't., Wm. Grant, Canada Bldg., Saskatoon, J. R. Reid, Swift Current, F. G. Kissack, Dom. Grain Co., North Battleford, and Jas. R. Clarke, secy.-treas. R. M. No. 336, Kuroki. Cheque for $1,000 required.

Watson, Sask.
H. S. Carpenter, Deputy Min. Dep't. of Highways, Regina, will receive tenders until May 23rd for roadwork from Watson to St. Gregor, Sask. Plans with Dep't., Wm. Grant, Canada Bldg., Saskatoon, J. R. Reid, Swift Current, F. G. Kissack, Dom. Grain Co., North Battleford and W. T. Smart, secy. treas. R. M. of Watson. Cheque or bond for $800 required.

CONTRACTS AWARDED

Anyox, B. C.
General contract for construction of water storage dam costing $345,000 for Granby Mining & Smelting Co., Anyox, is awarded to Dredging & Contracting Ltd., 904 Standard Bank Bldg., Vancouver. Jno. R. Eastwood, Engr., San Francisco, Cal.

Caughnawaga Reserve, Que.
General contract for construction of macadam road costing $75,000 on Chateauguay-Laprairie Highway for Prov. Gov't., Dep't. of Roads, is awarded to Kennedy Construction Co., 137 McGill St., Montreal.

Dartmouth, N. S.
Council awarded contract for cast iron water pipe to Canadian Fairbanks Morse Co. Ltd., 84 St. Antoine St., Montreal.

Halifax, N. S.
Prov. Gov't., Dep't. Pub. Highways, awarded following contracts for road construction: Liverpool town line to Mill Village, 8.77 miles, Standard Construction Co., Metropole Bldg., Halifax; Antigonish-Pictou County Line, 7.84 miles, W. J. Stewart, Yarmouth North; Salem Church, Alma, to Fisher's Corners, 10.05 miles, Fulton Bros., Merigomish; 1 mile east of Victoria Bridge, Bear River, to a point 2.9 miles west of Bear River, Nova Scotia Road Builders Ltd., Digby; Antigonish-Guysboro County Line to a point 8.85 miles south, Chas A. Mitchell, New Glasgow; Pictou-Antigonish County Line to Antigonish Town Line, 10.2 miles, Wm. Cook, North Sydney; Stewiacke town line-Truro town line, 15 miles, Nova Scotia Road Builders Ltd., Digby. W. A. Hendry, Engr., Hollis St., Halifax.

Gorman & Peckham, Roy Bldg., have general contract for construction of sewer on Quinpool Rd. for City. F. W. W. Doane, Engr.

General contract for construction of concrete sidewalks is awarded to Stockley Construction Co. Ltd., Pepperell St. Contract for retainig wall is placed with N. Dasckallino, 10 Compton Ave. F. W. W. Doane, Engr.

Kingsville, Ont.
General contract for waterworks costing $23,000 for Town is awarded to Jesse Sherman. R. W. Code, Engr., 116 Chatham St., Windsor, Ont.

General contract for paving Division, Main, Mill, Pearl, Spruce and Maple Sts. at cost of $11,000 for Town is awarded to Merlo, Merlo & Ray, Ford, Ont. R. W. Code, Engr., 116 Chatham St., Windsor, Ont.

Montreal, Que.
General contracts for construction of

ESTABLISHED 1886
Contract Record and Engineering Review

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Vol. 18 May 17, 1922 No. 20

The Annual Number

The annual number of the Contract Record and Engineering Review once more makes its bow to the contracting and engineering public. But it does so under conditions manifestly different from those under which previous annual numbers have appeared. Just what those changes in circumstances are is difficult to explain in a word; indeed these are almost a state of mind that brook no definite or clear cut elucidation. However, even a casual observer of business and trade conditions cannot help but detect a "something" that makes this year different from last year or the year before, or, indeed, any year within the knowledge of the present generation. And this "something" is bestowing its influence on the contracting and engineering professions just as much as on other lines of commercial and business activity, making engineering and contracting a different thing from engineering and contracting of a few years ago.

In what way and to what extent the construction industry is different this year it is one purpose of this annual number to explain, and this it has attempted to do by a series of articles that cover industrial conditions in all parts of the country. These must by no means be considered exhaustive, for on a topic of such importance there is bound to be much left unsaid. The salient features, however, are covered, it is hoped, in a manner that will give our readers a good working knowledge of the situation and enable them to understand the basic reasons for the present condition of the industry. In this connection the series of articles on the present market conditions as far as building commodities are concerned will be illuminating.

What are the prospects for this year? That question is one in which our readers are very keenly interested and in order to get as true a forecast as possible, we have carefully canvassed representative cities from coast to coast. The prospects for construction as seen by competent officials of these districts are summed up in an article that, in its tone of optimism, should offer encouragement and inspire confidence in the minds of contractors and also the public at large. While some few centres report a certain amount of inactivity, these conditions, in most cases, may be traced rather to some local influence than to any widespread depression. On the whole, construction labor is being well employed, financial conditions are easing, markets are loosening and people are buying, so that the future holds no serious bugbear for the building industry.

As is fitting in an issue of a special character, such as this annual number is, outstanding construction and engineering projects have been described in articles which, we are sure, will be eagerly read by contractors and engineers who are anxious to study the methods adopted in handling some of the big projects of the past year. There is no need at this stage to make specific reference to these.

In another editorial note, reference is made to the water works articles contained in this issue. These have been included by reason of the interest that is stimulated in water supply matters by the meeting of the American Water Works Association, which is being held this week. The appeal which these special articles make to water works officials needs no further comment at this point.

In commending this number to our readers, let us urge, as we did in our annual number of a year ago, that our readers write to the editor giving their own viewpoints on the topics discussed in this issue. We should like to have our readers' viewpoint and can guarantee careful attention to any correspondence in this connection.

Special Water Works Articles

Inasmuch as this annual number appears coincidentally with the meeting in Philadelphia of the American Water Works Association, of which organization Canadian water works officials form a large and important section, a number of special articles of direct interest to water works men is included in this issue. These articles have been selected to cover a sufficient range of topics to appeal to water works officials of all classes and all degrees of experience. In the character of the information these articles impart they will be seen to be eminently practical—a quality that water works men demand in their reading these days. Theoretical considerations are essential, of course, to the acquisition of a proper perspective of water supply matters, but their development may be left largely to text books, which obviously cannot deal with the practical problems of the water works engineer, superintendent or operating official as effectively as the more frequently issued trade or technical publication. For this reason, the editors, in selecting the articles for publication in this issue have kept in mind the practical viewpoint that holds the strongest appeal, we are sure, to the designers and officials of water supply systems.

In the article by E. M. Proctor dealing with the trend in the design of small town water supply plants, some of the characteristic tendencies of modern practice are explained. During the past twenty-five years much development has taken place in the science of water supply and purification, with the result that the plants which are supplying water to our municipalities today have attained an efficiency that surpasses all previous experience. The various elements that have helped to achieve this result are explained by Mr. Proctor in an article that is comprehensive without being too detailed.

An article that will appeal to suburban officials is that by R. O. Wynne-Roberts, outlining the water supply and distribution schemes of York township, bordering the city of Toronto. The point that should be emphasized in connection with this article is the fact that the engineers of York township have had foresight enough to adopt the standards of the adjoining city so that should the township ever be annexed, the two systems will form an integral unit. Such careful attention to the layout of a suburban scheme is not any too general and the article will, therefore, be illuminating to many water works officials in similar municipalities.

Some new ideas in pipe line design and construction are brought out in a description, by J. B. Holdcroft, of the Humpback reservoir overflow in Victoria, B. C. Part of the equipment of this work comprises a 1960 ft. steel pipe with a 270 ft. fall, every joint of which is welded and which when completed is to be subjected in test to the full hydrostatic head due to its fall of 270 ft. The job will therefore be of interest in showing the possibilities of a method which is still comparatively new as applied to pressure work.

Other new ideas are presented in an article by H. M. Burwell on the Maple Ridge Dyking District in British Columbia, a 9,000 acre area which has been reclaimed for agricultural purposes. The new pumping plant which performs this service is the main subject of the article and readers will be interested in its design, which includes unusual features.

Labor Costs and Production

Any labor agreements that have been arranged since the publication of the last annual number of the Contract Record have, as a rule, been on the basis of a decrease in the rate of wages. In some instances, no change has taken place in the wage, last year's rate being maintained for another season. However, the general tendency has been downward, the employees accepting a compromise between the 1921 scale and that offered by the employers. In many cases, the latter have taken advantage of the widespread unemployment and general inactivity in construction to enforce a scale without negotiation, but as a rule, agreements have been made in which each party has sacrificed a little in order to reach a mutually satisfactory basis of wages. Naturally, Labor fights any tendency to cut wages but, in general, is willing to recognize the necessity of stimulating activity and causing re-employment of the building trades. Of course, there have been instances where labor has been an unwilling loser, the bricklayers' action in Toronto coming to mind in this connection. In that city, the wage dispute was put to a board of arbitration after both sides had agreed to accept the decision, but when the award meant a decrease in the scale to the extent of 7½ cents an hour, a strike was called. We are glad to say that such unwillingness to abide by an arbitrator's award is not generally shown by the saner labor element.

Labor costs are undoubtedly lower than a year ago, but we are forced to admit that the scale of wages in the building trades has not dropped to the same extent as material prices. This fact has led to the frequent statement that labor is responsible for the huge cost of building. This assertion, while possibly a little too sweeping, is in general correct inasmuch as labor costs directly or indirectly form the bulk of the cost of construction—authorities state 80 per cent. Labor thus holds some responsibility for any inactivity in construction.

In the matter of production, we believe that conditions are generally recognized by contractors as satisfactory. A year ago we stated that the productive effort of building mechanics was showing very marked improvement—a statement which we can safely reiterate this year. Slackness and inefficiency are no longer accepted attributes of labor but, on the other hand, productiveness and efficiency seem to have gained ground.

A Message from the Leader of the Construction Industry in Canada to the Readers of the Contract Record

To the Construction Industry of Canada:

At this the beginning of a new construction season permit me to say one word to all the members of our association, to the members of kindred associations and to the construction industry at large.

We have passed through a period of depression—little or no business—competition so keen that profits were at the vanishing point—overhead becoming a nightmare—a period when it required the greatest effort even to smile and keep going.

And we are not yet out of the woods. Industrial building is still away in the distance, but other work is coming forward usually from quite unexpected quarters. The wheels have started again. Let us hope they will not run too fast. Let us work for a slow, steady, sane recovery.

Building costs are down and, if we are to retain public confidence, they must be kept down. We must be prepared for a few dangerous little surges—temporary periods of rising prices—but the general trend must still be downward.

We must give every ounce of our energy towards this end, and to accomplish it we must also face squarely what is perhaps the greatest problem in our industry—how to make it attractive to the younger generation of artisans so that a plentiful number of real skilled workmen shall always be available.

Don't look backward—"Prosperity is 'round the corner."

J. Carswell

No one has taken keener interest in the welfare of the Canadian construction industry or performed harder work in its behalf than J.B. Carswell, whose appointment this year to the presidency of the Association of Canadian Building and Construction Industries was a recognition of his outstanding qualities of leadership. His foreword to this annual number of the "Contract Record" is a message of optimism to the construction industry at large.

A Forecast of Construction

Prospects in Important Building Centres

Authoritative Advance Information from a Score of Cities from Coast to Coast Indicates That, with Few Exceptions, Contractors May Expect an Active Season — A Better Year Than Last Seems to be the Consensus of Opinion

Moncton It is rather difficult at this stage, writes F. D. Hope, building inspector of Moncton, N. B., to give an accurate forecast of the building operations in this city for 1922, but the present outlook is that this year will see greater activity in the building line than in last year. I venture to say that the valuation will amount to approximately $875,000., made up as follows:

Dwellings	$300,000
Church	100,000
Schools	175,000
Public Buildings	150,000
Garages and Repairs	150,000
	$875,000

* * *

Montreal The situation in Montreal is considered very promising by members of the Montreal Builders' Exchange. It is stated that prospects for building this year are brighter than they have been for some time. There is an ample supply of labor, both skilled and unskilled, while if there is no difficulty with the unions and a general willingness to meet present conditions on the part of the workers, with a recognition that in order to do business wages must be reduced, so as to bring down costs of construction, there is every prospect of a lively and profitable building season in Montreal and district.

Building contractors stated that they are optimistic for a good year if they can only be sure of a steady supply of labor at prices which would admit of increased building, and at the same time be assured that work undertaken will not be delayed by strikes or the cost increased by demands for higher wages, which had delayed building operations here in the past.

At a general meeting of the Exchange on May 5 it was decided that a general cut in wages in the building trades should be enforced, amounting to from 10 to 30 per cent. This change, it was decided, should become operative at the beginning of the pay week nearest the first of June, 1922. As in previous years the Builders' Exchange, as an organization, decided only to fix the maximum rates of pay, thus permitting members to make individually their own arrangements with their own workers, either at or below the maximum rate, these rates to be fixed according to the earning capacity of the men employed, no arrangements for dealings with unions being considered.

According to the arrangement, as adopted by the Builders' Exchange, bricklayers, who last year got 90 cents an hour, will this year be offered a maximum of 80 cents, scaling down according to the amount of work done by the men.

Last year unskilled building laborers received a maximum of 40 cents an hour. This year the maximum offered will be 30 cents an hour, with the same provision for scaling down on men who could not do the maximum day's work.

The same scaling down in wages applies to all building trades, and will become effective at the same time. In each case the Builders' Exchange has stipulated that the scale proposed should be the maximum, thus leaving the way open for contractors to make such arrangements as may be suitable with their employees.

In accordance with these ideas the following letter was issued from the Builders' Exchange to all the contractors, members of the Exchange, which carried out the plans emphasized at the general meeting;

At a general meeting of this association, held here recently, it was decided that the following be the maximum wages to be paid by members of the Exchange during the current building season, the same to become effective on he first day of the pay week nearest to June 1st, 1922:

Unskilled building laborers, 30 cents per hour; carpenters, 60 cents per hour; plasterers, 80 cents per hour; painters, 60 cents per hour; cement finishers, 60 cents per hour; masons, 80 cents per hour. Bricklayers, 80 cents per hour when at work within a reasonable distance of the city car tracks; and 85 cents per hour when at work outside of this.

* * *

Quebec During 1921 there were 810 permits issued in Quebec city and the total value was $3,693,397.00. This was the best year yet on record. The prospects for this year are brighter than at the beginning of last year, and if the indications of the work offering are carried out, the total value of last year will be much exceeded.

The principal pieces of construction which are projected are; the continuation of the enlargement to the Chateau Frontenac Hotel, value $1,500,000.00; an annex to the court house, value $40,000.00; the Canada Hotel Co. Ltd.'s proposed new hotel, value $1,500,-

000.00. The site for this new hotel is now practically arranged with the city. The Harbour Commission will have $1,500,000.00 to spend and I understand that this amount includes the erection of a cold storage warehouse to cost $750,000.00. I understand that there are at present permits for over one hundred residences to be started this spring. There are some schools projected but we have nothing definite now. There is also the continuation of the St. Sacrement Church, on which an amount of $150,000.00 at least should be spent during the summer.

The above projects, some of which are under way, others which will surely be done, together with the regular amount of repairs, alterations and additions to exising buildings, should provide ample work for the building mechanics in the city during this season.

The city will have about $1,000,000.00 to spend on new pavements, repairs to existing ones, and also to some of its buildings.—O. H. Cote, industrial commissioner, Quebec. P. Q.

* * *

Westmount . . I would say that it looks as if this year will be at least equal to last year, when the value of the permits issued amounted to $1,576,293.00. During March of the present year, the value of permits issued amounted to $76,700.00 and the total to date for the year is $86,100.00. There are about forty dwellings under consideration, also two stores with apartments, one apartment building and a new city hall.—P. E. Jarman, city engineer, Westmount, P. Q.

* * *

Sherbrooke Mr. W. S. McSwiggin, building inspector of Sherbrooke, P. Q., writes: 1921 permits in Sherbrooke, P. Q., totalled $752,900 in value. Prospects for 1922 are encouraging; looking forward for large amount of construction work. This year several buildings have already been started. The most important ones are:

Sherbrooke city hall	$90,000
Sherbrooke No. 5 fire station	25,000
Sherbrooke Dufferin bridge	75,000
27 private houses $6,000 to $15,000	
1 commercial building	55,000
1 residence	85,000
	$330,000

1922 Prospects.

1 Catholic church	$60,000
1 High school	80,000
1 Baptist church	27,000
1 Catholic school	45,000
10 private residences, municipal housing	60,000
Also several small private residences.	
	$272,000

* * *

Peterborough There is optimism among Peterborough, Ont., contractors as far as this year's prospects are concerned. From conversations with some contractors, it is an easy matter to tabulate in detail an expenditure in buildings, roughly estimated, at more than half a million dollars for this year's operations.

First, there are three factories, one of which involves an outlay of $150,000, another $100,000 and the third $50,000. One of them, the Western Clock Company's new plant at the corner of Hunter street east and Armour road, is regarded as a certainty. The second has been held in abeyance for a year, but the plans are ready and will be dealt with one way or another shortly. The third factory expansion is also as good as begun.

In the certain column is also included the Collegiate Institute extension with its technical school annex, amounting to $150,000 in round numbers. Members of the Board of Education have intimated that they are forced to launch this work right away to meet the present demand for accommodation, and especially the additional pupils that will be compelled to continue their studies under the Adolescent Act's regulation. That brings the total to $450,000.

Coming down to smaller items in the half-million-dollar list, the new rectory for the church of the Sacred Heart has been announced for early undertaking. It will cost around $25,000, and Mr. Andrew Brown's new motor emporium at the corner of Charlotte and Aylmer streets means probably another $30,000 or more.

D. Bellegham & Sons, have planned extensive alterations to their furniture store and undertaking establishment, estimated at $12,000, and G. H. Duncan is contemplating the erection of two stores and apartments on Charlotte street, immediately west of the residence of R. Hicks.

Although the Millbrook School Board returned the marked cheques to the contractors who had tendered on the former plans and specifications. It is learned that the board has arranged for new plans and will shortly invite new tenders This is not a Peterborough job, but it is in the district and means an expenditure of $30,000. There is also a $15,000 job in Lindsay for Claxton's dry-goods store, the plans of which are being prepared by Mr. W. H. Barry.

Enquiries about houses have been increasing, and it is believed that there will be at least four times more houses built this year than last. Reduced to paper, the programme is an encouraging one, and there is every reason to suppose that Peterborough will have considerable building activity during the present season.

* * *

Toronto An astounding amount of building work is in progress in the Toronto district the greater part of it being residences. At the present rate of going, it would seem that the year's aggregate for Toronto would almost double the high-water mark of $25,000,000 established in 1919. Allowing for a slackening as the season progresses, there is more than a chance that all previous records will be broken in 1922. The start has been most auspicious.

Perhaps no better evidence of this condition is afforded than the records of the city architect's office for the first three months of the year. In January and February of 1921 building permits were issued for constructional work to the aggregate value of $1,322,397. For the same period of this year permits were issued for building work representing an investment of $2,867,629, or more than 100 per cent. increase, and in March of 1921 the total value of permits issued was $1,806,572, while in March, 1922, the record of approximately $2,900,000 aggregate value of building work was undertaken.

The volume of building work undertaken during 1920 and 1921 remained almost constant, and, in so far as Toronto is concerned, averaged $2,000,000 a month. A conservative estimate of the average monthly expenditure in building construction in 1922 places the figure at $2,500,000, or a total expenditure for the year of approximately $30,000,000.

Every factor points to a revival in building construction. Labor costs have decreased very slightly, but builders claim that labor is more efficient and that the average building trades worker does a greater amount of work per hour than he did a year ago. Material costs, while still high on the basis of the costs of 1913, are generally very much lower than they were in the early months of 1921, and it is not regarded as probable that prices will recede very much farther, while land values are showing a natural tendency to increase coincidentally with the increasing activity in housing construction and the present urgent need of houses of all types.

Building labor is well employed. Unskilled labor is also fairly busy, due in large measure to the work of rehabilitation being pushed by the Toronto Transportation Commission. The renewal of activity in outdoor work means that unemployment in Toronto is reduced to the lowest level in many months. Provided that building work continues at the present rate, Toronto will be enjoying prosperity greater than any city of its size on the continent.

* * *

Stratford The prospects as regards industrial and building activity for 1922, in Stratford, Ont., are stated as follows by A. B. Manson, city engineer. Buildings contracted for or assured up-to-date are as follows:

Schools	$153,000
Mausoleum	50,000
Hospitals	84,000
Church	18,000
Store	4,000
Dwellings	36,000

To this amount may be added work which is anticipated at once to the amount of $28,000 being dwelling houses.

The prospects for 1922 are at present quite hopeful and we look for a very active year in building construction.

* * *

Kitchener Conditions in the building line augur well for the current year as far as Kitchener and Waterloo, Ont., are concerned. There has been some activity for several weeks in both towns. While the cost of building still remains high and while quite a number of people who have been contemplating to build this year are holding back owing to the cost still being higher than they had anticipated, the indications are that the season will show a big improvement over last year.

In Kitchener the city itself has a big program on its hands. The erection of a new city hall at a cost of at least $250,000 will be undertaken this year.

Other municipal buildings to be put up this year are the collegiate and technical school at a cost of $498,000 and the annex to Suddaby school at a cost of $162,000.

The building activity occasioned by private enterprise is reflected in the number and value of permits issued which very greatly exceed that of the corresponding period of last year. The figures are $686,025 compared with $296,010.

The neighboring city of Waterloo also expects a promising season.

* * *

London At present the outlook is exceedingly brighter for 1922. The larger buildings which are certain to start this year are, a new hotel costing $1,500,000.00, new schools costing approximately $200,000.00, Western University building costing $250,000.00. Besides the above mentioned buildings we can easily figure on the expenditure of $1,000,000.00 for dwellings which with smaller buildings bring the total for 1922 over the three million dollar mark.

Last year we erected buildings here costing $2,527,510.00 which was the record year for London, but as shown above we will overstep this amount by at least $500,000.00.—A. W. Piper, building inspector, London, Ont.

* * *

Fort William The prospects for building in Fort William, Ont., for 1922 is still in an embryonic stage, and outside of $200,000 for school buildings, nothing definite has been lined up for other work, although considerable work is anticipated consisting of apartment blocks, dwellings, elevators and a possible paper mill, before the end of this year. Data on possible expenditure is unobtainable at this date.—S. Macnamara, building inspector, Fort William, Ont.

* * *

Port Arthur The developments, so far guaranteed and now under construction in Port Arthur, Ont., are as follows:

1. Erection of a grain terminal elevator for the Parrish & Heimbecker Company.

2. An additional 1,500,000 bushel storage to Richardson & Sons' grain terminal elevator plant.

3. Construction of a 10,000 ton Great Lakes freighter at the Port Arthur Shipbuilding Co.'s plant.

4. Besides this, there is now under development, the erection of a big paper mill for the Provincial Paper Mills Co., Ltd., to cost on completion approximately $1,500,000.

The total construction and equipment now under contract will cost in the aggregate about $3,000,000.

To give an idea of the size of the new unit of the Provincial Paper Mills Co.'s plant, I might say that this addition will be composed of five buildings of the following sizes:—Screening room, 61 x 108, two storey; Clay storage bldg., 38 x 79, three storey; Machine rodm 79 x 271, two storey; Finishing room, 147 x 130, two storey. All these buildings will be of reinforced concrete and structural steel, an order for 600 tons of the latter material having already been placed. The machinery for this mill we hope will be given to the Port Arthur Shipbuilding Co., which besides being equipped with all facilities for the building of the finest ships, is also equipped with facilities for the making of all kinds of paper machinery.

The Kaministiquia Pulp and Paper Co. at Port Arthur, recently purchased by the Consolidated

Power and Paper Co. of Wisconsin Rapids, are also contemplating extending this plant.

We have a larger industrial expansion anticipated for this summer than for any year since 1913 and fully expect that all labor both skilled and unskilled will be fully occupied.—J. L. Matthews, Mayor, Port Arthur, Ont.

* * *

Winnipeg

Building in Winnipeg, though the question of reductions in wages must necessarily affect the situation to some extent, is considered likely to be very fair during the 1922 season, though not of that magnitude which was expected at the beginning of the year. The failure of the provincial government to put through the housing loan of $1,000,000 recommended by the committee on unemployment and urged in the legislature, will have an undoubted effect upon the building of residences in Greater Winnipeg; for while the necessary legislation to enable the city to borrow $800,000 for building loan purposes was put through, the participation of the provincial government and of the federal government in lending money for the construction of homes is rendered impossible by the failure to pass an appropriation for the purpose on the part of the province.

This means that not only will the million asked for from the province be unavailable, but the equal sum advanced by the federal government will also be unavailable. In other words, there will be $3,000,000 less money available for loans on new residence building in Manitoba in 1922, most of which would have been spent in Greater Winnipeg, than would have been the case if the provincial appropriation of $1,000,000 had been passed.

Notwithstanding this, however, the issue of building permits is most encouraging. Building material has shown considerable reduction since the opening of the 1921 season, and wage schedules also show reductions. The shortage of houses at the present time exceeds even the startling figures which were shown by the survey of the situation made last year. Business firms have for several years delayed building owing to excessive costs. Each year has added during that period to the number of firms whose premises require expansion to cope with their business, and notwithstanding the recent depression of trade, steps must be taken to prepare for the recovery, and buildings for industrial and warehouse purposes cannot be provided overnight.

Costs show signs of coming down in both wages and materials, so that there is less incentive to delay in building this year than for several seasons past.

* * *

Brandon

While it is not anticipated that the building activity in Brandon, will approach the record set last year, when the permits totalled $714,190, still there is indication that there will be a great number of small buildings erected this year. The majority of permits issued thus far, are for additions or small residences.

* * *

Regina

The building inspector of Regina, Sask., points out that there is very little activity in building construction so far this season though considerable house building is looked for as soon as weather conditions permit. The indications at present are that there will be very few, if any, large buildings, such as schools, theatres or churches, erected this year. The city is not contemplating any new public buildings and, so far as can be learned, the same is true of the government. The demand for houses in the city is such that rents are keeping up to the peak.

"As regards labor" the city clerk writes that wage schedules have been discussed but no definite decision arrived at. Labor of all classes is sufficient to handle any prospective construction work. It is urged in some quarters that present prices of material and the cost of labor have a tendency to delay the commencement of construction. Our Building Department is not infrequently informed by prospective home builders that they find it almost impossible to obtain money at reasonable rates to finance their proposals."

While actually more permits have been issued during the first three months of 1922 than during the same period of 1921, they represent building construction of only about one-half the valuation of the permits issued January 1 to March 31 last year, or a total of $72,615 for 90 permits as compared with $145,475 for 88 permits for the same period of 1921.

During the first three months of the year, the building inspector's department has issued eight permits for small fully modern residences ranging from $2,500 to $4,000 in estimated cost. With the exception of $10,000 for the repairs of the Regina Theater in January, and $3,700 for alterations at the Stadium, the balance represents construction of stables, garages, verandahs, sleeping porches and alterations and additions to existing residences and a few hundred dollars for alterations and additions to stores.

Permits have been issued this year for two fully modern residences at an estimated cost of $4,000 each; four at $3,000 each, and two at $2,500 each.

W. G. Van Egmond, of Storey and Van Egmond, when asked as to prospects for the coming season said he had received several inquiries from the East from prospective clients who might build in Regina. He stated he was advising them that the present was an opportune time to build, as he believed that lumber was now down to rock bottom price and would probably advance next year.—Geo. Beach, city clerk, Regina, Sask.

* * *

Saskatoon

Mr. Geo. D. Archibald, city engineer of Saskatoon, Sask, outlines the situation in that city as follows: The prospects of a better building year than last seem to be rather good. The following work is practically assured,

Chemistry building, University of Saskatchewan	$500,000
Presbyterian College	50,000
Power house for City Hospital	30,000
Probable stores, public garages, etc.	75,000
Average number of alterations and additions	125,000
Dwellings and small apartment blocks	500,000
	$1,380,00

In addition the following buildings were proposed for last year and held over, and while there is yet no assurance that they will be carried out this year, it is quite possible that they will be,

Collegiate Institute	$100,000
L. R. Steele Co. stores	150,000
Lutheran College extension	50,000
McDonald-Crawford warehouse	100,000
Victoria Theatre (remodelling)	50,000
	$450,000

From the above figures it will be seen that it is quite probable that we will have about $2,000,000 worth of building during the coming year.

* * *

Edmonton The building permits issued for the first three months of this year show a marked improvement over the same period last year, being $124,850.00 as compared with $87,535.00 last year.

It is difficult to estimate what building will take place during the current year, but according to present indications we believe a very substantial building program will be undertaken. The city is making arrangements to build an isolation hospital, a library, telephone exchange, and sewage disposal plant.

The reduced cost of material, together with an unusually large number out of employment, would indicate that wages will be very much lower during the present year, which will encourage building by people who have been postponing construction work for a number of years.—D. M. Duggan, Mayor, Edmonton.

* * *

Victoria The building prospects for 1922 show a steady improvement judging by the number of dwellings in progress and in contemplation. There are no large buildings in sight beyond the alterations just commenced by the Woolworth Company, to cost approximately $60,000., and the new wing to the Jubilee Hospital. Up-to-date the progress is indicated by the permits for January amounting to $38,760; February amounting to $34,020, and March amounting to $109,482. Generally, employment in the building trade cannot be said to have reached fair.—James Bart, building inspector, Victoria, B. C.

How Is Business To-day and How Will It Be To-morrow?

Experience of Past History Indicates the Presence of a Business Cycle, the Ever—Recurring Nature of Which Enables the Future to be Reasonably Forecasted—The Present Time in the Light of this Law of Business Operation

The regular recurrence of business cycles seems to be something more than theory. In normal times, i.e., when, over a long term of years, no political upheaval like the recent World War projects its disturbing influence into the arena, it seems reasonably possible to map out, in more or less detail the trend of business during the months to come, and, guided by the experience of past history, plot a curve of future developments with a fair degree of accuracy. Indeed, it seems quite possible that the disturbances to the regular cycle caused by the war are evidenced by their intensity rather than their permanence and that just as the waters of our lakes and oceans, lashed into a frenzy by a great wind storm, swell and heave for a time but gradually settle down into their regular wavey motion, so the ocean of business, totally disorganized by war's upheaval, also swells and heaves in readjustment but soon resumes its normal way. If such is the case, it is exceedingly interesting and instructive to take stock of our present location in this ever-recurring cycle.

Some two years ago the National Bank of Commerce, of New York, published a fair sized review of the theory of business cycles, which we printed in part in our issue of June 23, 1920. In this article what was called the "normal business cycle" was divided into five sections—four of them clearly defined—as follows: 1. Depression. 2. Revival. 3. Prosperity. 4. Financial strain and liquidation of securities. 5. Brief crisis and liquidation of commodities. The symptoms, so to speak, of each of these phases were given in more or less detail, but on account of the chaotic conditions of trade and finance in general at that time it was not easy to place one's finger on any point and say definitely "There we are to-day."

However, the financial sea has settled down considerably since that time and we have less difficulty in taking our bearings. The following paragraph, quoted from this article, undoubtedly shows an unmistakeable resemblance to the present moment in our history:

"At the end of a period of depression we find the following situation: 1. Prices are low. 2. There have been drastic reductions in cost. 3. The margins of profit are narrow. 4. Bank reserves are high. 5. Conservative policies obtain as to borrowing, capitalizations and loans. 6. Stocks of goods on hand are moderate. 7. Buying is cautious. In such a situation an expansion in the physical volume of production and sales takes place, often with prices still falling."

The article goes on to define further the conditions that obtain at the end of the period of depression and the beginning of the period of revival, as follows: "There comes then a slow and cautious revival and expansion in the physical volume of trade. Slow at first, this process is cumulative and it gradually turns slow business into active business." And again, "The price level is often slowly falling when the revival begins, but the expansion of trade stops this. When business men have plenty of orders they stand out for higher prices. Moreover, when prices start to rise the expectation of higher prices makes buyers increasingly eager. The rise of prices, like the volume of trade, spreads rapidly through all fields." In other words, the old law of supply and demand again asserts itself.

It would be difficult to give a better outline of conditions that have existed during the past year than are contained in the above quotations. Evidently we've passed the purely "depression" stage and have started to climb the curve that is called "revival." It may be too optimistic to say we are near the top, but it seems to be certain that we are travelling in the right direction. Another six months or a year should see us approaching the summit.

Another firm believer in the cycle theory is Roger W. Babson, who has outlined what is known as "Babson's cycles." Mr. Babson considers the cycle as beginning the peak of prosperity, which is accompanied by large profits and high wages. This is followed by a period of inefficiency, accompanied by declining bond prices. Next comes the period of dishonesty and profiteering, accompanied by declining stock prices. Then the periodic crime wave and the decline of commodity prices. The next step in the ladder is shown in lack of confidence in business circles, which results in general unemployment. As a result, people cut down living expenses and real estate prices decline. Mr. Babson places this as the end of the general decline and the beginning of the improvement section of the cycle.

As indicating a turn for the better, thrift becomes more evident, which results in declining interest rates, allowing banks to loan money to start new buildings and again set the wheels of industry in motion. The unemployment condition has produced greater efficiency in the workman. Bond prices begin to rise. People become more honest and fairer prices are asked by both retailers and labor. Renewed religious interest is evident, resulting in restored confidence, greater buying, and strengthening of commodity prices. Finally a period of great activity is reached in all lines, with labor fully employed. The cycle has been completed; extravagance and waste are again in evidence, with high money rates.

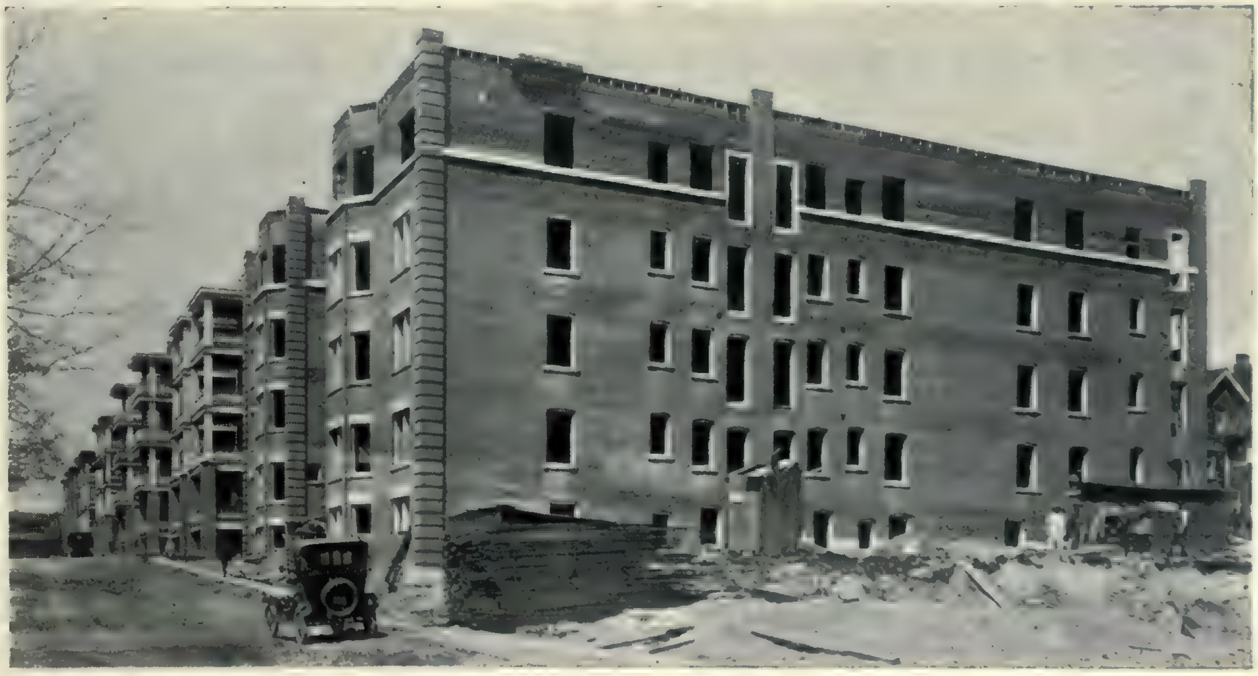
From this it would appear that we are well up the hill and within measurable distance of normal conditions.

Again, it is common saying that the stock market is the best barometer of general conditions. It has been pointed out time and again that a drop in bond prices precedes a decline in stock prices, which in turn is a forerunner of an industrial depression. In the same way a rise in bond prices is followed by a rise in stocks and, a little later, by the return of general business to normal.

This also would seem to check up with our previous conclusion. Six months or more ago Canadian bonds began to show unusual activity. This was followed a little later by upward movements in the general stock market and to-day we are due for a revival in general business, which, according to the theory of the cycle, we must inevitably experience.

Perhaps the greatest difference between the depression we have just passed through and previous depressions is the effect of the housing shortage and the unprecedented demand for good roads. These two items are bound to be a very important factor in bringing business back to normal. It seems to be a case to-day where theory and necessity are working hand in hand. We believe we may confidently look for a period of general business activity, beginning with the present summer.

2,000,000 Bricks in This Pile



The east side of one short block on Kendal Ave., Toronto, has already accounted for over two million brick. Building activity in apartments, as shown in this picture, has probably never been exceeded anywhere in the Dominion. The building in the foreground, nearing completion, will house twenty-six families. Seven other apartments in the row, of varying size, bring the total number of suites to 118, varying in size from four to seven rooms. These apartments have been erected by J. W. Walker, 250 St. Clair Avenue West.

The Status at the Present Time of

The Building Materials Market

Comments on the Current Prices, Stocks and Production of Important Construction Commodities—The Probable Trend of the Market as the Season Progresses

Cement—By J. Lavelle, Alfred Rogers, Ltd.

The market situation at the present time with regard to cement is showing no outstanding changes. Outside of a price drop of 10 per cent. or more about six months ago, nothing further in price revisions has developed. Dealers and manufacturers do not anticipate any reductions in the immediate future and can only promise a steady price for this building season. It is claimed that the factors involved in the manufacture of cement have shown no alleviation in the past few months, freight, labor and coal all being very high in price yet. So far the coal strike in the United States fields has had no direct effect on the retail price of cement, but manufacturers claim that if the strike is long continued, the mills will feel the result. Labor has eased off but freight on fuel is high enough yet to make the mill price higher than it would be if some reduction were to be made in this item. High transportation charges, of course, also effect the laid-down price of cement.

From cement company officials, it is learned that stocks are heavy at the present time. On account of this fact, the mills are capable of taking care of any orders that are offered. The market is considered very indefinite at the present time, as the absence of any great activity in the industrial building line is leaving considerable mill output unabsorbed. Roads and hydro-electric developments are really the only active consumers of cement at this time. If construction opens up in any great volume—especially industrial building—the increased demand for cement will absorb much of the surplus stocks. In the meantime, the price remains firm with plenty of cement on hand to care for all orders offered.

Brick—By J. B. McFarren, Interprovincial Brick Co. of Canada, Ltd.

Conditions in the brick business since the last annual number of the Contract Record, as they exist with my companies, have been very unusual. The spring of 1921 opened up, as is customary in the spring time, with a very considerable volume of business, largely consisting of residential work. By the early part of July, however, this trade dropped off very materially and the remaining months in 1921 were anything but encouraging.

It was possible to make certain savings in the cost of manufacture as compared with the previous year's costs although the savings in costs have been more than absorbed by the reductions in prices, and as a matter of fact the 1921 prices were lower than costs justified, considering the comparatively small production and the consequently high overhead charges.

Early in March of the present year a distinct improvement in the demand occurred, especially for residential work in Toronto and vicinity as well as some of the Western Ontario cities. The consequence has been a marked shortage, especially of common brick, during the past couple of months. This increase in demand is no doubt accounted for by the fact that mortgage money has been easier to obtain and many houses are being erected to fill the long felt shortage. It seems unfortunate whenever there is a little more than the normal demand for brick that it is impossible to get anything like prompt deliveries, but on the other hand, if it were possible to get prompt deliveries of brick it would be impossible to get sufficient bricklayers as there are not enough bricklayers in Toronto to satisfy what should be even normal demand. Brick is such bulky material and so expensive to handle and store that from an economic point of view it is not possible to successfully operate a plant which is big enough to cope with an abnormal demand for brick and at the same time pay its way during seasons or perhaps years when the demand is not brisk.

The brick-making industry is one industry at least which has never taken advantage of the tariff. Brick of practically all classes in Canada is being sold for a lower price at the plant than similar material is being sold for at the shipping point in the United States, and these United States plants very often have the advantage of either mining their own fuel or obtaining it locally with little or no freight expense. At the same time Canadian brick is about 10 per cent. larger than the brick of United States manufacture, so that from the users' point of view, brick can be obtained on a very economical basis in this country.

Unfortunately, very little relief has been given in regard to freight rates, which are undoubtedly excessive as applied to brick in comparison with pre-war rates of brick as compared with other materials. It is to be hoped that our present government will take some action to relieve this situation, as undoutedly more equitable freight rates would stimulate the building industry throughout the country and do much to improve the general situation, as large building operations are usually fore-runners of increased business in practically all lines of trade.

Structural Steel—*By J. L. Brower, Canadian Allis-Chalmers Co., Ltd.*

Compared with other elements of building construction, the price of structural shapes and plates has declined to a lower level and is now closer to the 1913-14 rate than any other class of material and labor for similar purposes.

The pre-war cost of steel compares with May, 1922, as follows :

	1913-14 Cts.lb.	1922(May) Cts.lb.
Mill base price (without extras)	1.20	1.60-1.70
*Canadian price (Montreal and Toronto)	1.67	2.20-2.30
Fabricated price at shops (offered)	3.10	3.35-3.50
Erected price, large structures (offered)	3.80	4.00-4.25
Average shop labor rate (hour)	22.	40.
Average erection labor rate (hour)	37.	80.

*Duty, freight, exchange and taxes included (f. o. b. shop.)

To the raw material price in the 1st and 2nd items there should be added in tendering the expense of fabrication and erection, the making of designs, the drafting, the shop costs, including power and other overhead evpense, as well as templet material, use of machinery and tools, inspection and supervision, workmen's insurance, paint, transportation of material and men to the erection site and a certainty of at least 4% material adjustment for wastage, punchings, etc., as well as the cost of the stocking up with from 3,000 to 5,000 tons of selected sections for an efficiently operated plant. The interest on this capital invested will naturally be large.

Notwithstanding the increased labor cost in the shops the erected price has recently been on a par with the 1914 price. This is accounted for by the fact that the larger shops, as a rule, make special efforts to retain their staffs and the experienced men of their shop organizations; they also figure at cost and sometimes without "overhead."

Recent contracts in New York have been let as low as $58.00 per ton erected for large buildings. This is equivalent to $75.00 to $80.00 a ton for Canadian work.

Structural steel for buildings is now more economical than concrete work and compares well with "mill construction" at present prices, when all factors are considered and included. Three months ago the big mills were operating at from 30% to 40% of their capacity; at present they are running 75% to 80% and over, and shipments are offered in 6 weeks or more. This of course helps warehouse business and implies preferential treatment or an advantage for those shops carrying large stocks.

The last weekly bulletin for rolling schedule from the Bethlehem Steel Company showed 24 items marked "closed" before issuing, whereas the week previous only 16 were closed and the week previous only 6, indicating that large beam and column sections now ordered would be deferred for possibly from 6 to 8 weeks or perhaps to the time of next regular rolling. Mill prices during April have advanced $5.00 per ton.

The week of April 20th showed contract bookings of 90% of capacity of all the U. S. fabricating shops. This improvement is also reflected by better conditions in Canada, and we feel that we have reached and "scraped the bottom" and are emerging from the low level to more normal operating conditions.

Railway work at present is scarce and is not an important factor to large shop production. Industrial and office building work with considerable municipal and government projects are, however, large items for new tenders and contracts.

We might note here that the last quarterly dividends of the Steel Corporation and the

Bethlehem Companies were paid but not earned. The remedy can be assumed as a future higher unit price or lower wages for steel workers (this is unlikely) or the advantage of increased production and a slightly increased rate at the mill. We look for the higher level of price to ourselves and to consumers but not large enough to seriously affect or set back large projects.

A careful analysis of the present conditions indicate a tremendous revival of large building work and ,considering that the increase of only 20% to 30% over the 1914 erected rate will be the prevailing price for this season for steel, there should be no lack of activity for structural shops. Other trades vary from 75% to 150% increase over 1914. We have been helping the others to average up. They should come back and offer a helping hand to the structural shops. We have a feeling of absolute certainty that prices for fabricated steel are lower now than they will be generally for a few years to come.

Lumber—By F.H. Pratt, R. Laidlaw Lumber Co.

Lumber for building purposes—and by that we mean hemlock joists and scantling, hemlock roofing and underflooring, lath, shingles and pine flooring—advanced during the period of the war and for a short while after—1914 to 1920—to an average of approximately 130 per cent. over the pre-war prices. The peak of the advance occurred during the years 1919, 1920 and 1921. Since that time, the various lines of lumber used for building purposes have dropped in price until the average advance over 1914 prices is now only approximately 50 per cent. This represents the amount of the increase that the average bill of house material, exclusive of trim, doors, etc., will show in 1922 over 1914 prices.

During the past year, owing to the drop in selling prices, mill owners have materially reduced their cut. This, with the increased demand which has sprung up, will tend toward keeping prices of building lumber at their present level. Indeed, these factors may possibly lead to an advance in prices as the season progresses and the shortages of stocks become apparent.

A brief comparison of the principal items involved in this review is as follows:

	1914	1919-21	1922
Hemlock	$30.00	$65.00	$40.00
Pine flooring	34.00	90.00	70.00
Lath	4.75	22.00	14.00
Shingles	3.90	10.50	6.00

Vitrified Clay Products

— By A. G. Dalzell, Vitrified Clay Pipe Publicity Bureau

The outlook for the vitrified clay industries for the year 1922 is somewhat difficult to determine. With the increased activity in building construction there is sure to be a demand for the smaller sizes of sewer pipe and for wall coping and flue linings. It is believed that the demand for the latter will continually increase as the advantages of building chimneys in this way is now becoming well known. The fire insurance underwriters' strongly endorse the adoption of this form of building construction and many municipal authorities have made it compulsory by their building by-laws. By so doing they have no doubt greatly lessened the fire risk within their municipal area and therefore, when the underwriters' revise the rates for those municipalities they will get the benefit of lower insurance. If it is once realized how serious is the fire loss arising from defective flues and chimneys it is certain that few municipal authorities would hesitate to adopt by-laws making this safer construction of chimney's compulsory. Some indications of the loss is afforded by a recent statement of the National Board of Fire Underwriters' of the United States that 36 per cent. of the total loss by fire within the States during the five years just past can be attributed to defective flues and chimneys. While no such definite figures can be given for Canada, yet when it is remembered that Canada has the largest capita loss of any nation in the world, it is doutful if the proportion in the Dominion is any less.

However, whilst increased production is looked for in all vitrified clay products used in building construction, the outlook for increased demand for sewer pipes for municipal works is somewhat uncertain. There has been a tendency by municipal authorities to utilise the construction of sewers as a means of affording relief work to the unemployed. This tends to keep back the construction of sewers during the best working months of the year and increases the tendency of municipal authorities to do this work by day labor instead of by contract. Except in the larger cities, where experienced day labor gangs are constantly employed, it is doubtful whether this policy is an economical one, but it has been justified by the bonus received from the Dominion and provincial governments as their contribution to the unemployment situation. The effect on the production industries is, however, that orders are placed in smaller quantities, and it is very difficult for the factories to anticipate requirements so that exceptionally heavy stocks have to be carried.

There is a steady demand for sewer pipe and drain tile arising out of the extensive highway improvements that are taking place throughout the province of Ontario, and the paving of streets within municipal boundaries. It is now generally recognized that drainage is the prime essential to secure a satisfactory and permanent roadbed, and that vitrified clay pipe is the ideal material. Many state highway authorities in the United States are using second quality sewer pipe exclusively for underdrainage work.

With the greatly increased building construction now going on in the outskirts of all the large towns in Ontario it is confidently expected that very soon there will be a demand for extensive construction of sewers and that as the general unemployment situation improves sewer construction will be again undertaken by contract and at lower prices than have prevailed in the past few years.

In the Maritime provinces development has been checked by unsettled labor conditions and the unrest in the coal mining areas. In the West no great development in municipal work is expected for some time. Most of the towns and cities undertook so many public improvements in the boom years before the war that provision has been made for some years of normal growth. The activity in the building industries will however, provide a steady if limited output until financial conditions improve with the influx of a new population.

Prices of manufactured goods have fallen but are still kept up by the high freight rates on coal and clay and the unfinished products. Labor has not been difficult to secure and has been fairly well employed throughout the year, but it is not expected that there will be any great expansion in the industries during 1922, although it is believed that with the general turn to more prosperous times the outlook is brighter than it has been for many years.

Millwork

In a review of the millwork industry which was included in the annual number of the "Contract Record and Engineering Review," published May 18th of last year, it was stated that the impression was prevalent that this industry would not experience a strong active demand until the spring of 1922. Contrary to the success which usually attends a prediction of this kind, this impression was correct, for the sash and door factories, planing mills and general woodworking plants in practically all parts of Canada are to-day feeling the result of the increased activity in the residential building field, and are faced with an unusually strong demand for their products. In certain localities, the demands being made on the woodworking fraternity are such that in spite of their most feverish efforts, they are unable to keep ahead of the volume of orders coming in.

It is gratifying to be able to record that even though faced with a flood of business, there has not been any noticeable tendency to boost prices. True, the element of keen competition is lacking and cut prices are not the order of the day, but on the whole present-day values in the millwork field are reasonable and are based on low costs figured at replacement values.

As might be expected, the wave of increased building activity which is sweeping the country, is being felt right down the line. The demand for building lumber is such that in certain sections many items are scarce and difficult to secure. This holds true of stock like 2 x 4, 2 x 8, 2 x 10 hemlock and similar items. The manufacturers of hardwood flooring are also benefiting, for oak, birch and maple flooring are in strong call. One dealer in lumber, who operates a planing mill and woodworking plant, recently stated that during April his organization made 2,800 deliveries. Included in these were ten cars of shingles and over 2,000,000 feet of hemlock.

It is not probable that there will be much change in millwork and lumber values. Any decided tendency toward higher prices would have the effect of checking building activity and would be a move in the wrong direction. There is a likelihood, however, that before the building season is over there may be a marked shortage of certain stocks; for instance, shingles are scarce to-day, and this may have some effect on prices. In addition, all signs point to higher hardwood values due to a shortage of stocks and low productiveness on the part of hardwood mills. Any change in hardwood quotations is bound to be reflected in the cost of all items into which hardwood enters.

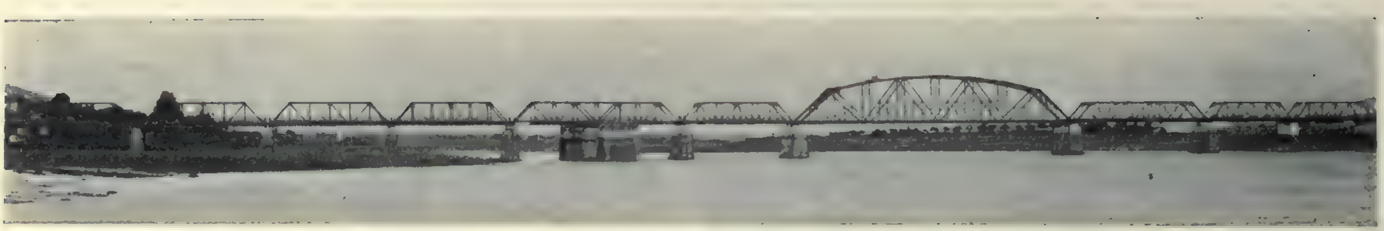


Fig. 1—A general view of the Annapolis-Granville bridge

The Annapolis-Granville Bridge

An Outstanding Construction Project of the Past Year

1. The Substructure

Consists of Ten Piers and Two Abutments of Concrete Either Reaching to Rock or Resting on Close-Faced Crib Foundation—Unusual Difficulties Successfully Overcome

By J. E. BELLIVEAU
Assistant Chief Engineer, Provincial Highways Board, Nova Scotia

In Western Nova Scotia an arm of the Bay of Fundy enters in by an unbridgeable gut opposite Digby and forms a body of water which stretches away as far as Annapolis where there descends into it a river of no mean proportion, named after this place, which affords navigation facilities for many a mile further into the interior. The Annapolis River and this body of water leave between them and the Bay of Fundy a tongue of land until recently entirely separated from the main land except by a ferry. This tongue of land contains a large number of populous villages which had clamoured for a bridge for over one hundred years. Although this section of the Province can boast of having the first road constructed in America, when soon after his arrival at a point nearly opposite Annapolis, DeMonts had constructed a road to the Digby Gut for military purposes, it nevertheless labored under the inconveniences of having to trade with the main land over a ferry operating between Annapolis and Granville Ferry immediately opposite.

Bridge Long Needed

If the construction of a bridge was delayed for such a long time there were naturally good reasons for the delay. These reasons are evident to anyone knowing the conditions and the difficulties. Granville Ferry is located at the mouth of the Annapolis River at a point immediately opposite the town of Annapolis and about half way between Digby Gut and the town of Bridgetown (where the river has been bridged for over a century,) the distance between these latter points being about thirty miles. The only practical location for a bridge, if one was constructed, was at Annapolis. And here the engineer was met with a problem of bridging a river with a width of slightly over one quarter of a mile, subject to the full effects of the heavy Bay of Fundy tides. The greatest depth in the river at this place at low tide is 45′, and the extreme difference of tides is 31′.

The port of Annapolis for a considerable length of time has carried on a rather extensive trade of a certain kind and was handicapped by ice which accumulated in the river in its vicinity. The theory was advanced that this ice could be harnessed to some extent by means of ice piers built across the river. This was a matter over which the province of Nova Scotia had no jurisdiction. Suffice it to say that the Federal Department of Public Works in the year 1909 began the construction of a line of piers at this place and in the year 1913 it had completed these piers, ten in number. As the province of Nova Scotia was not a party to the construction of these piers no details of the work can be given. Soon afterwards, however, an agitation was begun for the construction of a superstructure on these piers and it was in this way and at this time that this province first became concerned

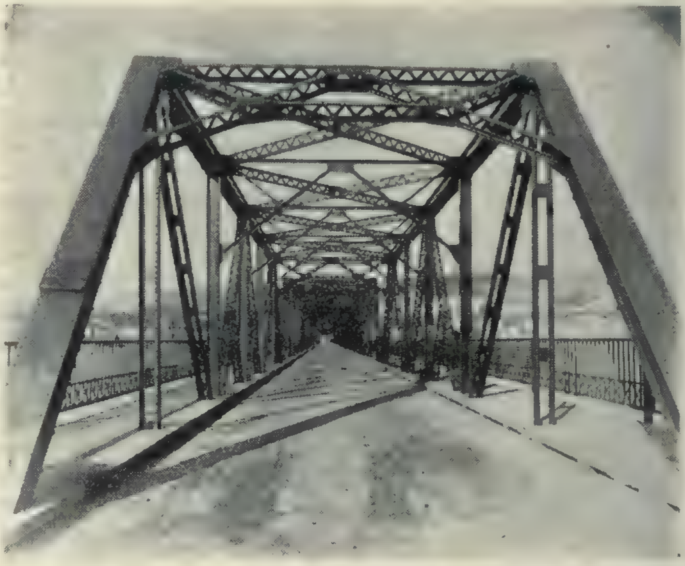


Fig. 2—End view of the completed structure

in the matter. An examination of the piers as existing and a survey for additions to complete the work to serve as a substructure for a bridge were then made and a decision reached as to the type and amount of work to be done as regards the superstructure and the substructure.

In the year 1917 tenders for the superstructure and the completion of the substructure were called for, received and considered, but it was seen from the tenders that the price of steel erected had then increased to such a high figure that it was deemed advisable to delay the construction of the superstructure in the hope that it would descend early in the future. The work on the substructure was delayed as well. No further action was taken in the matter until two years later when the work on the substructure was again advertised for bids and at this time a a contract was let. At the beginning of 1920 the superstructure was also let on new bids received.

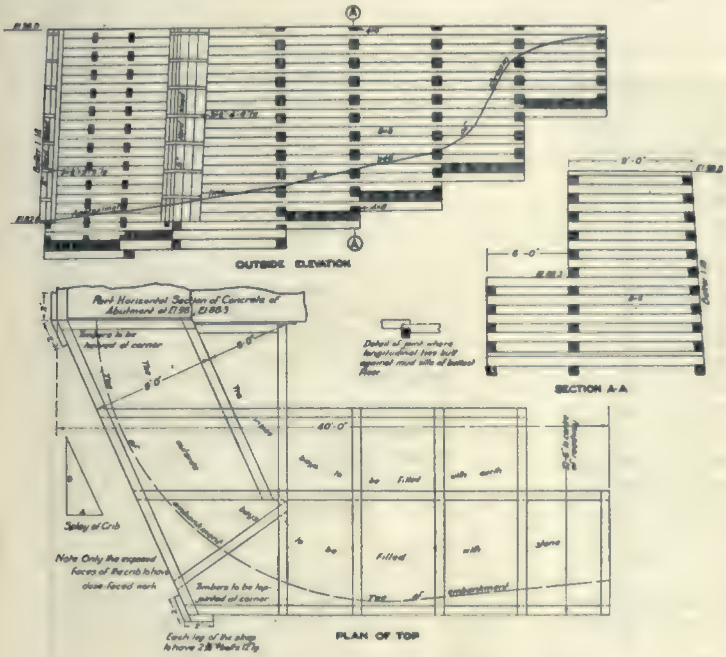

OUTSIDE ELEVATION
SECTION A-A
PLAN OF TOP
Part Horizontal Section of Concrete of Abutment at El 98, El 88.3
Timbers to be halved at corner
Detail of joint where longitudinal ties butt against mud sills of ballast floor
8'-0"
6'-0"
40'-0"
to be filled with earth
to be filled with stone
Splay of Crib
Note Only the exposed faces of the crib to have close faced work
Timbers to be lap-jointed at corner
Toe of embankment
Each leg of the strap to have 2

Fig. 3—Details of crib retaining walls

The contract for the substructure was awarded to Engineers & Contractors, Ltd., Annapolis, N.S. This firm had constructed seven of the ten piers previously built. The work covered by this contract consisted of the construction of a concrete abutment and an approach thereto of earth fill and rip-rap protection at each end of the bridge with crib retaining walls additional at the Annapolis end; of two crib rest piers for the ends of the swing span when opened; and of concrete pedestals on the top of each one of the ten existing piers. A section of the river is shown in figure 4.

Difficult Conditions

It should be borne in mind that any work in this river cannot take exception to the worms which infest these waters and to the action of frost and ice between high and low water levels, in this case a tremendous difference of 31 feet. It is found, however, that the worms do not operate in the tidal difference except in the vicinity of low water, and in the case of this proposed work there was no place where timbers going into the construction would be affected. Frost and ice, however, were two factors which entered fully into the consideration of the work.

As previously stated the approaches at each end were an earth fill with stone rip-rap protection. At the Granville Ferry end it was found more economical to let the slopes down to the bottom but at Annapolis end the height of the fill at the abutment made it necessary to resort to the construction of retaining walls. These walls were built of cribwork close-faced on the exposed surfaces and filled with stone in the outside bay while the inside bay was allowed to be filled with the earth material which composed the fill. These extended to the elevation of high water of neap tides to ensure permanency. From this level to about three feet above high water the slopes of the earth fill were well protected with hand-laid riprap. If the retaining walls had been allowed to extend above the level stated the extra height would fail to be immersed in water during the period of neap tides and the life of the wood would be thereby shortened. Every exposed corner was sheathed with five inch birch as protection against ice action. Figure 3 shows the details of the work built.

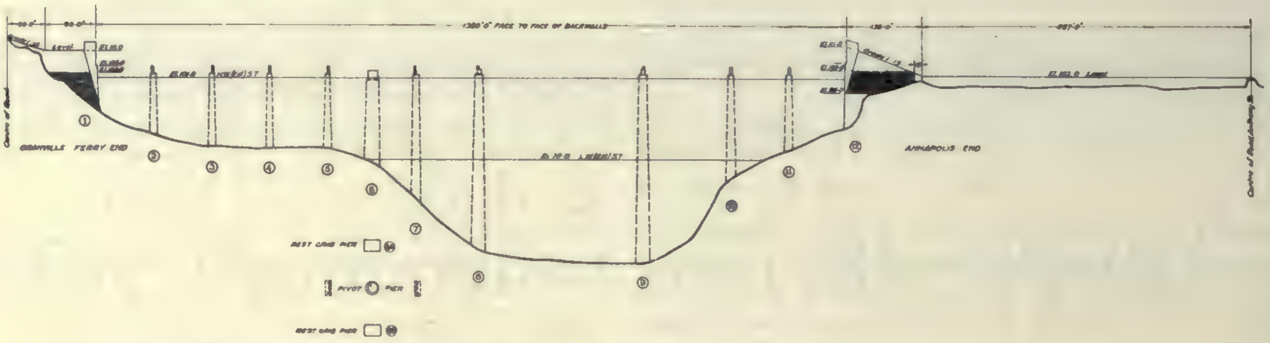
One of the ten piers previously built was constructed to serve as a swing pier and as its location was at a difficult point of the river it became necessary to construct of massive form the piers which receive the ends of the swing span when opened. The current at this place is very swift at certain stages of the tide and navigation cannot be controlled so well as it could be on the other side of the river. The rest piers constructed here were built of closefaced cribwork completely filled with stone and of a size of 20 feet by 30 feet at the top. The corners were protected with five inch birch as protection against ice action. Figure 5 shows the details of this work.

Abutment Construction

The foundation for the abutments was found good at about three feet below the surface where the bottom presented hard ground thickly studded with boulders. The concrete composing the abutments consisted of a 1:2:4 mixture and of stone fillers. The abutments were built of a U-shape but the wings were not brought down to the foundation for their entire length, as the cost could be lessened without the purpose served by the wings being impaired. As the wings were brought up they were stepped out in such a way as to completely hide the steps inside the finished embankment. In building the forms for the abutments, 8 inch by 8 inch spruce was used in the front face from the foundation up to the elevation of high water of neap tides and is left as an integral part of the work to serve as protection against frost and ice action. In order to ensure effective bonds between the wood and concrete, before the concrete was poured, seven-eighths inch iron dowels were driven through the wood and allowed to project inside a distance of about one foot with the end turned at right angles in the form of a hook. The two corners of the front face which are the only exposed ones were protected by five inch birch sheathing. Figure 6 shows the details of the abutment at the Annapolis end.

Only a passing remark need be made of the construction of the concrete pedestals as these merely consist of small concrete blocks about three feet high at each end of the piers to raise the superstructure to a higher level.

As was stated above, this province was not con-



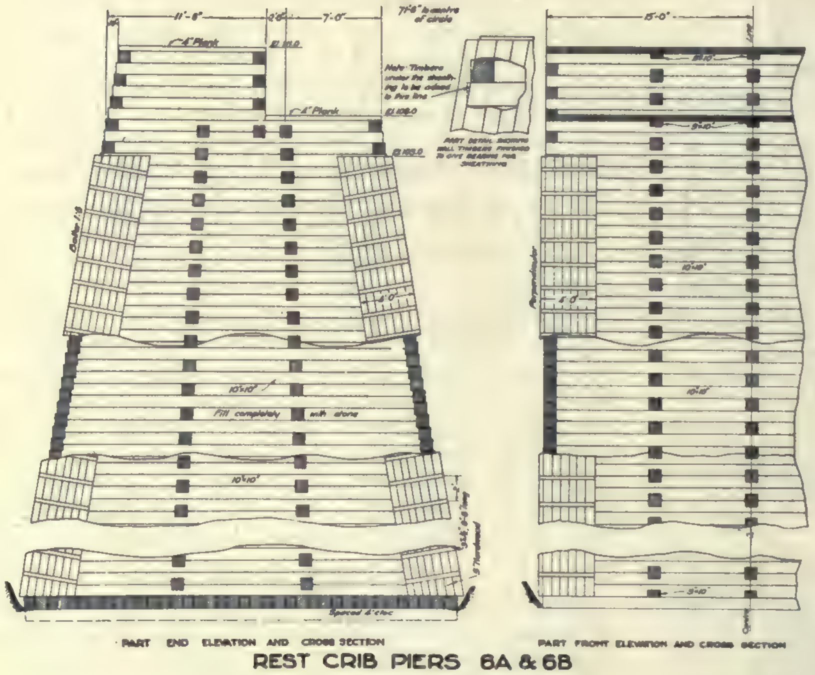
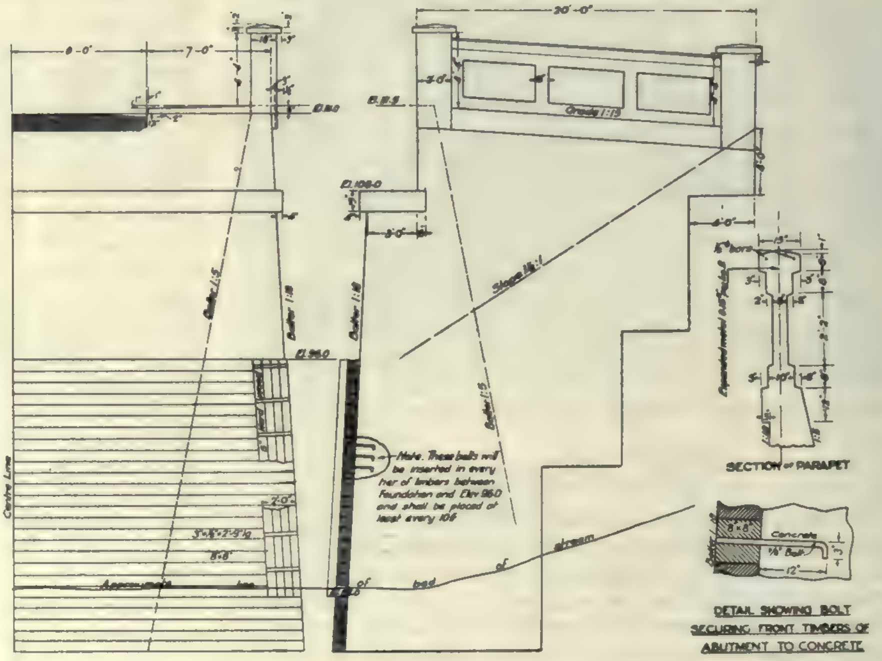

11'-6"
2'-6"
7'-0"
7'-6" to centre of circle
15'-0"
4" Plank
4" Plank
El. 111.0
El. 108.0
El. 103.0
Note: Timbers under the sheathing to be adzed to fire line
PART DETAIL SHOWING WALL TIMBERS FRAMED TO GIVE BEARING FOR SHEATHING
Batter 1:8
Perpendicular
6'-0"
5'-0"
10"x10"
Fill completely with stone
10"x10"
5"x10"
Spaced 4' c to c
PART END ELEVATION AND CROSS SECTION
PART FRONT ELEVATION AND CROSS SECTION
REST CRIB PIERS 6A & 6B

Fig. 4 — (above) Elevation and part plan of piers, abutments and embankment approaches.

Fig. 5 — (left) Details of rest crib piers for swing span.

Fig. 6—(right) Details of abutment at Annapolis end, shown as No. 12 in Fig. 4


8'-0"
7'-0"
20'-0"
3'-0"
El. 111.0
Grade 1:12
El. 108.0
3'-0"
Slope 1½:1
Batter 1:5
Batter 1:8
Batter 1:8
Batter 1:5
El. 96.0
Centre Line
2'-0"
8"x8"
Approximate line of bed of stream
Note. These bolts will be inserted in every tier of timbers between Foundation and Elev 96.0 and shall be placed at least every 10ft
SECTION of PARAPET
8"x8"
Concrete
⅝" Bolt
12"
DETAIL SHOWING BOLT SECURING FRONT TIMBERS OF ABUTMENT TO CONCRETE

cerned in the construction of the ten piers which were built previous to the beginning of the work covered by the contract of Engineers and Contractors Ltd., for this province, and consequently the design of the piers and their relative location were matters quite outside its decision.

At low tide five of the ten old piers are partly immersed. For these the construction from this level down consists of close-faced cribwork of creosoted timber filled with stone. Above this level for these piers and the other five piers the work consists entirely of concrete of a rectangular shape with the four faces exposed with the exception of the corners where iron plates offer a protection. Above high water level the concrete has been preserved in a remarkably good condition but in the tidal difference the ice carried in a swift current impinging directly on the concrete and the water penetrating into the concrete when immersed by the tide and freezing when the concrete surface is exposed to the frosty air have gradually damaged the outer crust of the concrete. When this crust is removed the rate of destruction is greater.

In the spring of 1920 it could be well seen that one of the ten piers had so ill-fared during the winter that repairs to it were not advisable. This pier was the first one at the Annapolis end and had been the first one built. It had lived eleven years. A new pier was constructed that year but this time the shaft of it was poured into forms of 8 inch by 8 inch timber with numerous dowels in the wood penetrating in the concrete to ensure snug contact. The forms were built in this size up to the level of high water of neap tides and being immersed every day will last indefinitely. The shape was varied from the old one, the new pier having a cut-water at each end. All corners were additionally protected. The condition of another one of the ten piers had reached a point in 1920 which forced repairs without delay.

Large Hole Scoured in Swing Pier

The pier which gave the province the greatest worry was the swing pier. A few months only before the swing span was ready to be floated into position it was discovered that under the pier a big hole, which had been gradually scoured away had reached such proportions as to incline a decision towards reconstruction. The short time available, however, made it necessary to make a strong bid to save it. The pier takes an octagonal shape of 26 feet diameter and the hole extended 9 feet in from the upstream peak and removed about one-third of the foundation bearing of the pier. The pier consisted of concrete to the bottom. The lower part was poured inside an open bottom caisson which was made to fit the bottom. This bottom was hard, being heavily studded with boulders. The caisson where the scouring had taken place extended about two feet below low water of extreme spring tides. These very low tides obtain once a month for two or three days only. It was at first believed that the hole was entirely under water but a second examination disclosed the fact that it extended inside the caisson. The caisson timber at this point was consequently blown clear away. The reason for the extension of the hole to a point higher than the bottom of the caisson was that the bottom portion of the pier was concrete laid in bags which naturally being left hanging fell down and were carried away by the current. The hole to be filled had a depth of about eight feet at the edge of the piers and it tapered to nothing at nine feet inside of it. Bags containing a rich mixture of concrete were carefully laid on the bottom beginning far enough from the pier to obtain a good slope and still reach the top of the hole two feet outside from the edge of the pier. Great care was taken to so place the bags as to obtain the minimum amount of voids by well tamping into place. The hole was completely closed and special care was taken to obtain a snug contact with the concrete of the pier all over the ceiling of the hole.

This work was completed barely in time for the floating of the swing span into place. The superimposed load about to come on this pier was estimated at about two hundred tons and had to be placed off centre on the undermined side to be in conformity with the best alignment of the ten piers. In spite of this difficulty the work below had been done with such success that it was deemed safe to locate the centre of the swing span only five-eighths of an inch on the opposite side of the alignment. The swing span was placed and inside of forty-eight hours it had reached proper alignment which it has retained to the day of writing. Before the winter set in, a massive block of crib work was built to preserve this work from being damaged by the ice.

With the exception of the repairs to one pier and to the foundation of the swing pier all of the work described above was done by "Engineers and Contractors Limited" and of a character which redounds to their credit.

Old Piers to be Repaired

As previously stated the portion of the work built by the Federal Department lying above low water level consists of concrete without any protec-

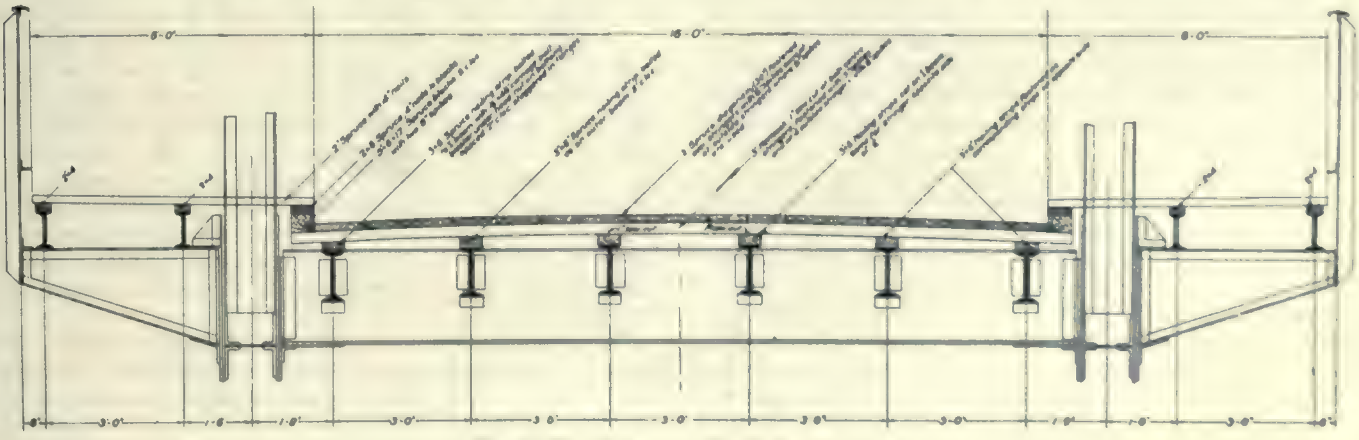


Fig. 7—Typical cross-section of floor system

tion against ice and frost action except at the corners. One of these piers has been renewed and another one already repaired. There remain eight of the ten piers to repair and it is intended to effect these repairs during the present year. For some of the piers the faces have been partly disintegrated. This work presents quite a difficult problem and it is not believed possible to effect these repairs for less than $50,000.00. The method to be followed is not yet definitely settled as experience will be gathered as the work progresses.

The contract for the superstructure was awarded in January 1920, as before stated, to the Dominion Bridge Company, Limited, but as the manufacturing of structural shapes at that time could not keep pace with orders, the contractors were forced to wait for their turn, and in consequence the steel was only delivered to the shops of the contractors the latter part of 1920 and the beginning of the next year. The steel then went into the process of fabrication and it was the middle of 1921 before the contractors could begin the erection of the superstructure, which covered a period terminating towards the latter part of September 1921. This superstructure is easily the longest of the steel highway bridges of this Province, measuring 1,360 feet from end to end.

2. The Superstructure

Ten Steel Spans, Aggregating 1360 Feet in Length, Built on Shore and Floated to Place on Scows—The Steelwork Design Shows Several Unusual Features

By R. E. JAMIESON, M.Sc.,A.M.E.I.C.
Of Robert W. Hunt & Co. Ltd., Inspecting Engineers, Montreal

The highway bridge over the Annapolis River, connecting Annapolis Royal and Granville, Annapolis County, Nova Scotia, which has recently been opened for traffic, presents some novel features in its design and erection. The structure was designed for the Nova Scotia Highways Board by Mr. W. Chase Thomson, M. E. I. C., consulting engineer, of Montreal, and was fabricated and erected during the summer of 1921 by the Dominion Bridge Company, Limited, who had the contract for the super-structure.

The bridge consists of ten through riveted steel spans, one of which is a swing span. It provides a clear roadway of 16 ft. with 14 ft. of headroom, and two 4 ft. 6 in. sidewalks, the latter being carried on cantilever brackets outside the trusses. The spans are of various lengths, the distance between the ballast walls of the abutments being 1360 feet. The structure contains about 870 tons of steel.

The piers which were used as substructure were built several years ago by the Department of Marine & Fisheries, being originally required on account of winter ice conditions in the river. They were not spaced to the best advantage for use as bridge piers, and this made it a difficult matter to obtain a pleasing outline for the structure. They are not spaced uniformly, and are much larger than ordinary bridge piers, but by placing the bridge seats unsymmetrically on them in some cases, it was possible to use six spans of equal length. The bridge is made up of six 102 ft. spans, one 157 ft. simple span and one draw span of the same length, one 109 ft. span, and one 294 ft. span, all lengths being centre to centre of end bearings.

All but the longest span have parallel chords, and for the sake of appearance were made a uniform depth of 20 feet centre to centre of chords, although some saving would have been affected in the case of the 157 ft. simple span had it been slightly deeper. The trusses of the 294 ft. span have polygonal top chords, with a maximum depth centre to centre of 45 ft. 6 in. The panel points of the top chord lie on a parabola, and on account of the even number of main panels in the span, no segment of the top chord is horizontal. In some cases such trusses have been designed with an odd number of main panels, and the panel points of the top chord have been placed on arcs of parabolas having their vertices at the ends of the horizontal central segment. Such an arrangement gives the truss an unnaturally flattened appearance. The pleasing outline of this span, which is largely due to the graceful curve of the top chord, adds greatly to the general appearance of the bridge.

The Warren type of web bracing was used throughout, both on account of the fact that it gives a more attractive appearance, and because, particularly in the polygonal top chord truss, it gives a larger proportion of tension members than is the case with other systems.

The bridge is designed in accordance with the specifications of the Nova Scotia Department of Works & Mines. The live load, Class "A," corresponds to loading for heavy city traffic. In the design of the trusses the specified live load was modified by allowing for live load only on the roadway. This was owing to the fact that the location and general conditions rendered extremely unlikely an occurrence of full load on both sidewalks and roadway at the same time. Provision was made in the dead load for reinforced concrete floor and sidewalk slabs. This combination constitutes a heavy loading for a highway bridge, resulting in a very solid looking structure. The total dead weight of steel, averaged throughout the bridge, is 1275 pounds per lineal foot of bridge.

Instead of the concrete floor provided for in the design, a plank floor was substituted. This consists of a transverse course of 3 in. hemlock and a diagonal course of 2 in. spruce forming the wearing surface, spiked to 3 in. x 6 in. spruce nailing strips bolted to the steel stringers. As provision had been made in the level of the stringers for a 2 in. crown on the roadway slab, the same crown was maintained on the plank floor, the plank being sprung into place and spiked. The sidewalks are floored with 2 in. spruce.

Mr. Thomson's fence railing shown in detail in Fig. 15, is a great improvement on the usual lattice type. A good view of it is given in the accompanying illustrations. The vertical pieces are 1⅛ in. x 1⅛ in. x ⅛ in. angles, spaced 7 inches apart, and riveted top and bottom to a 3 in. x 2 in. x ¼ in. angle. Shear bracing is provided by a lattice of 1 in. x ⅛ in. flats, 14 inches deep, and riveted to the vertical angles at all intersections. The top rail is a 5 in. channel. The original design called for a Carnegie T-rail section for this, but at the time of fabrication the material could not be obtained and the channel section was substituted. The fence was made up in the shop in panel lengths, and is bolted to fence posts which are riveted on each sidewalk bracket. It is very rigid in both directions.

Prevention of Salt Water Corrosion

On account of the fact that the structure is over salt water, the prevention of corrosion of the steel is an especially serious problem. Such surfaces as those between tie-plates in four-angle tension members, which are usually not more than three-eighths of an inch apart and possibly three or four inches wide, do not and cannot receive the attention in cleaning and painting which, in the experience of the Highways Board, is necessary for their proper maintenance under such conditions. In consequence the Board ordered that fillers be used in all such spaces.

Sliding Bearings for All Spans

The expansion bearings of the spans are unique in that, instead of the usual nests of rollers, sliding bearings are provided for all spans. The details of a typical bearing are shown in Fig. 13. The lower casting, which rests on a steel bed-plate on the pier, is finished on its upper surface, and scored with oil-grooves, This surface is raised half an inch above the remainder of the base. On the sides parallel to the centre line of the bridge, 5 in. x 3 in. x 7/16 in. angles are riveted to the base, and the upstanding 3 inch legs are planed down to ¾ in. above the bearing surface. These angles take the lateral thrust. Along the other two sides, 2½ in. x ⅜ in. flats are tap-bolted, and all joints are welded or packed so as to complete a shallow oil-tight open box some three-quarters of an inch deep. The bearing surface of the upper casting fits into this box, and 2½ in. x ⅜ in. flats tap-bolted to it around its projecting sides complete a dust-proof cover for the box, with sufficient clearances to permit of the movement due to the expansion of the truss. An oil hole is provided so that the bearing box can be kept full of oil.

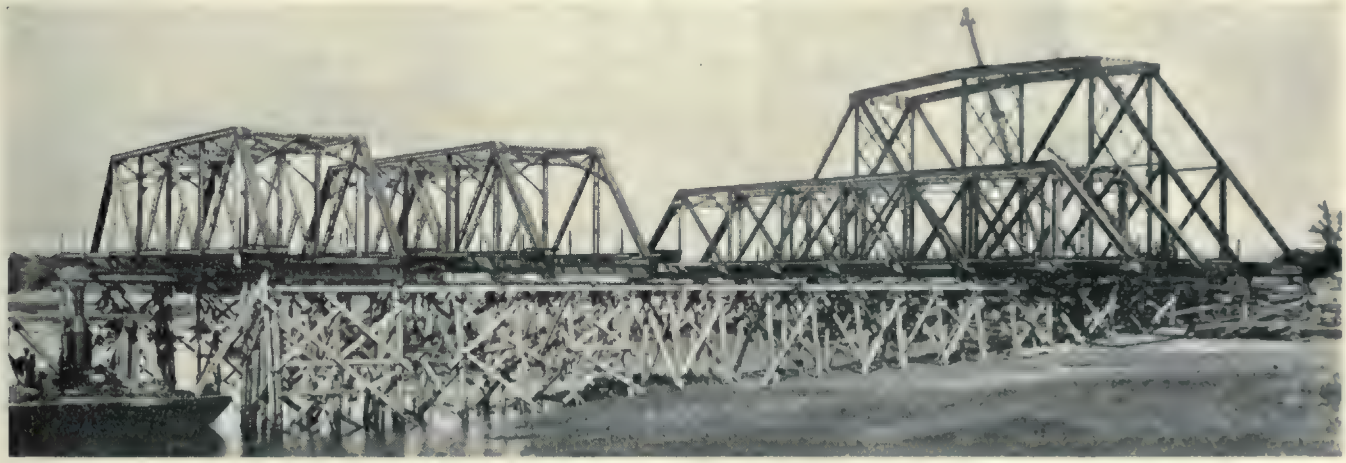


Fig. 8—Several of the spans completed ready for launching. The central section of the long span is assembled

This arrangement provides an expansion bearing which must always be fairly efficient. At the worst, if it receives no attention and the oil is not replenished, the bearing is entirely enclosed, and no moisture can lodge in it. It is thus likely to be in good working order long after the ordinary open nest of rollers is rusted solid. There is likewise nothing to get out of alignment, as frequently occurs with rollers. This type of expansion bearing was also used by Mr. Thomson on the highway bridge at Lennox Passage, Nova Scotia, built in 1914.

Swing Span Details

The swing span is centre bearing and capable of being turned through a complete circle. The end wedges are operated by line shafting running from a capstan at the centre to both ends of the span. Cranks and links connecting this shafting with the wedges are between the webs of the end floor-beams, which are double webbed plate girders. This arrangement obviates the necessity of level gears except at the capstan. An original feature of the mechanism is the method of operating the safety gates on the approach spans. Fig. 14 shows the details. The shaft "A," operating the wedge cranks, carries on its outer end an eccentric which, when the span is closed, bears on a lever carried in a bearing on the end floor-beam of the approach spans. As the shaft rotates, during the driving of the wedges, the eccentric forces the lever up. The inner end of the lever is connected by a wire rope and bell cranks to the safety gates, and its downward motion causes the gates to open. On drawing the wedges, preparatory to opening the draw, the pressure of the eccentric on the lever is gradually relieved, and the weight of the gates causes them to fall into the closed position. The scheme works very satisfactorily. The additional force required on the wedge-operating capstan, on account of operating the gates at the same time, is negligible.

The turning machinery of the span is of the ordinary circular rack and pinion type, arranged for operation by hand. High and low speeds are provided, for use by two men and one man respectively. The centre bearing consists of two tool-steel discs, fifteen inches in diameter, dished concave on one side, with a phosphor bronze disc, dished convex, between them. The whole is carried in a heavy steel casting and built-up collar, arranged so that the entire bearing can be kept submerged in oil and is protected from dust. The total weight of the span, including the plank floor, is about one hundred and for-

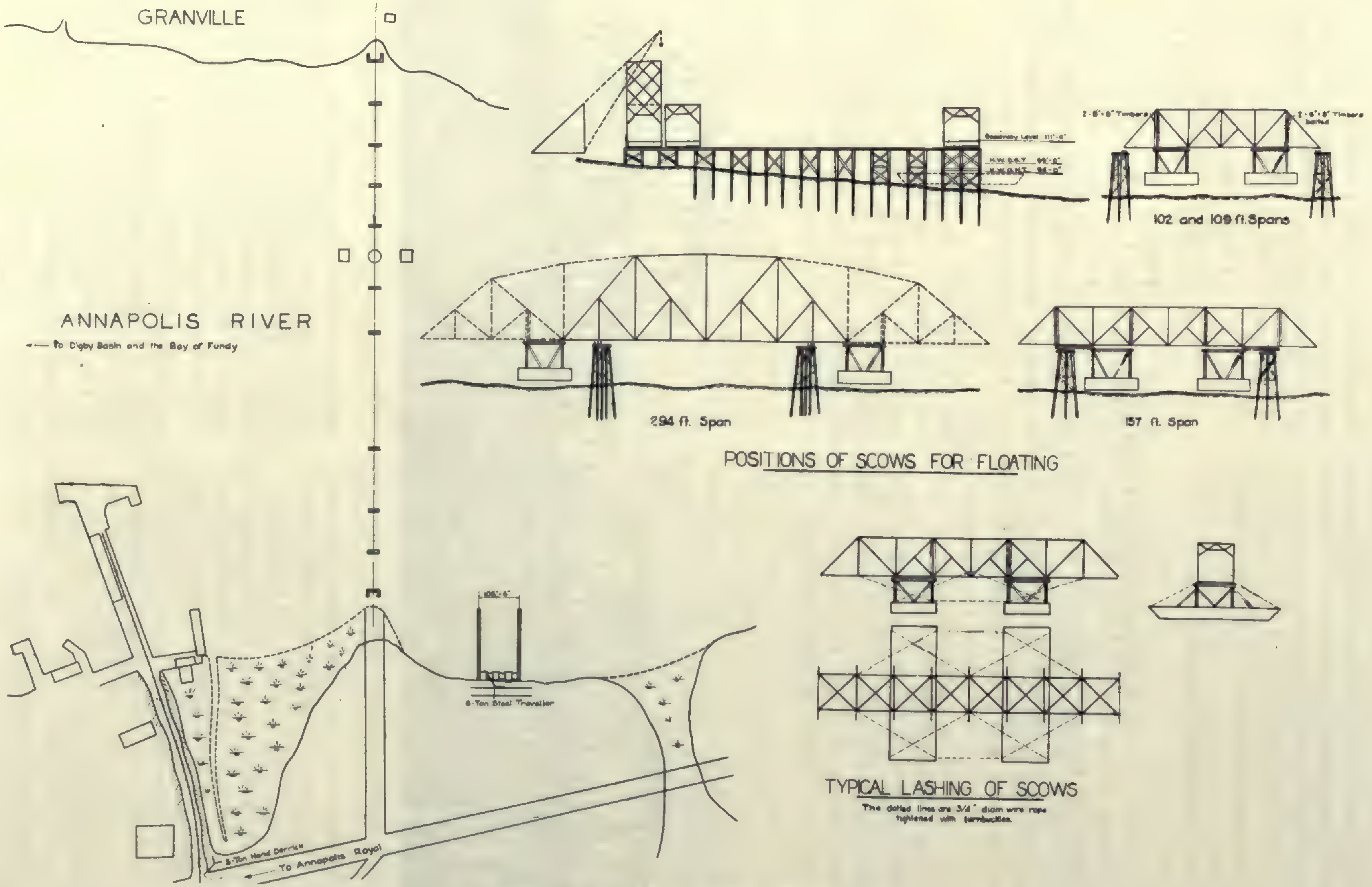


Fig. 9—Plan of bridge site and details of the steel erection

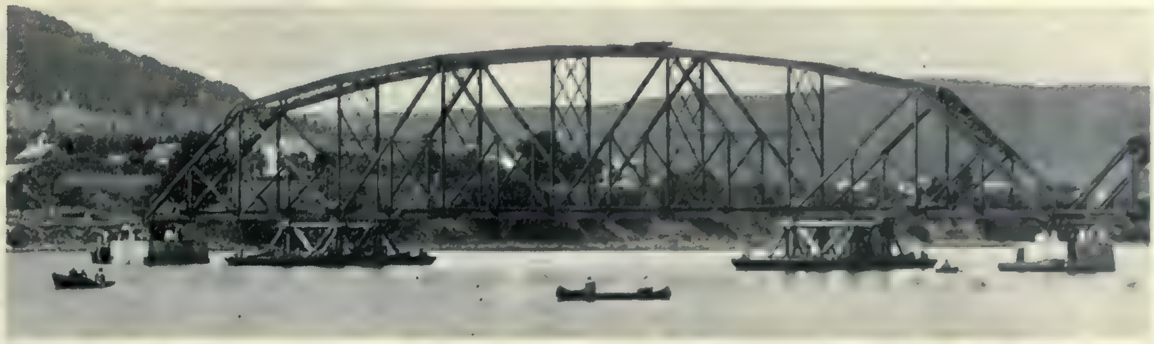


Fig. 10—The long span in position at the piers, waiting for the tide to fall. Note the framing of the sway bracing at U4L4, which resulted in the members having practically the same slope as those at the other posts, in spite of the difference in the lengths of the posts.

ty tons. The entire operation of opening the draw, including lifting the latches, drawing the wedges, and turning the span, can be performed within five minutes with two men working the turning machinery. This is well within the time estimated in the design of the gearing.

Difficult Erection Problems

The erection scheme was worked out in its entirety by the contractors, and great credit is due to their staff for the successful handling of a difficult proposition. The details of the scheme are shown in Fig. 9. At the bridge site the Annapolis River is subjected to a tidal range of some 26 feet, reaching a maximum at spring tides of about 29 feet. At extreme low water there is about 45 feet of water at the piers at the ends of the long span, with somewhat greater depth between these piers, and during ebb and flow the current attains a velocity of about fifteen miles per hour. "Dead water" at the turn of the tide is practically non-existent; the current on the surface may be upstream when the tide has actually turned long enough for the level of the water to have fallen an inch.

Impossible to Use Falsework

The erection of the spans in position on falsework was therefore out of the question except for two or three of the spans nearest shore. The contractors decided to erect all spans on shore, and float them into position on scows. Steel was delivered on the Annapolis side on a spur from the Dominion Atlantic Railway to within about a quarter of a mile of the erection yard, to which it was hauled by team. Falsework was erected parallel to the shore line and above high water mark, and two parallel pile trestles, 105 ft. 6 in. centre to centre, were run offshore at right angles to this. The stringers for these trestles were the twelve-inch I-beam stringers of the 294 ft. span, three lines of I's side by side and close together being used on each trestle. Spans were assembled on the falsework in order as they occur in the bridge, beginning from the Annapolis end, and, as soon as riveted, were moved on rollers to the end of the trestles. The trestle caps were long enough to permit of shifting the stringers laterally so as to bring them under a panel point, except in the case of the two 157 ft. spans. The points of support for these spans were about one-third of a panel from the nearest panel point, and three 12 in. I-beams were used on each corner to bridge between the floor-beams.

Method of Handling the Scows

The two scows used in floating the spans into position were built for the job by Messrs. Clark

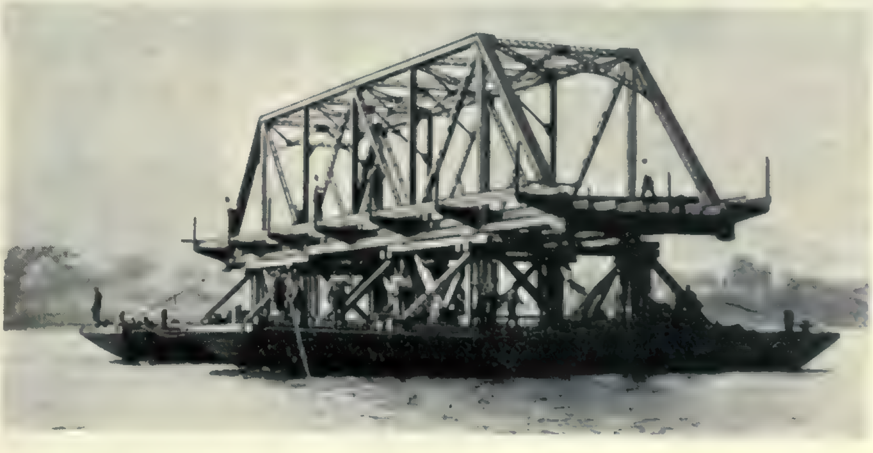


Fig. 11—One of the 102 spans. being floated to the piers.

Bros., of Bear River, N. S. There dimensions were as follows :

At bottom	24 ft. x 50 ft.
At deck	24 ft. x 70 ft.
Depth, out to out	6 ft. 8 in.
Height of falsework above deck	10 ft. 0 in.
Draft in condition to receive spans	1 ft. 1 in.
Draft when carrying 294 ft. span, floating weight 236 tons	4 ft. 11 in.

Each scow carried a two-drum hoisting engine, mounted on its deck on the upstream end. One drum of each engine carried a ⅞ in. wire rope attached to a deadman which was embedded at low water mark about half a mile upstream from the bridge site, this line being buoyed at intervals to prevent it fouling the bottom as the scows moved across the river. A short line anchored at low water opposite the trestles served to pull the loaded scows clear of the trestles, and for the first three spans a line to the pier at each end of the space the span was to occupy was sufficient to pull the span into place.. On reaching the piers, hand-tackle attached diagonally to the corners of the span and the piers, and the wires to the deadman upstream, served to hold everything solid as the current set outwards on the turn of the tide. In the case of the long span and subsequent spans, a line was laid directly across the river, and anchored on the Granville side. It was impossible to buoy this line owing to interference with navigation, and it occasionally caused trouble during the crossing by fouling the boulders on the river bottom. A line was also run from each scow to the piers or to spans already in position, to assist in pulling the scows across, the points of attachment being shifted forward alernately as the scows came opposite them. A line anchored near the trestles was paid out from one of the scows during the passage across, and was used in conjunction with the long upstream lines to pull the empty scows back to the Annapolis side.

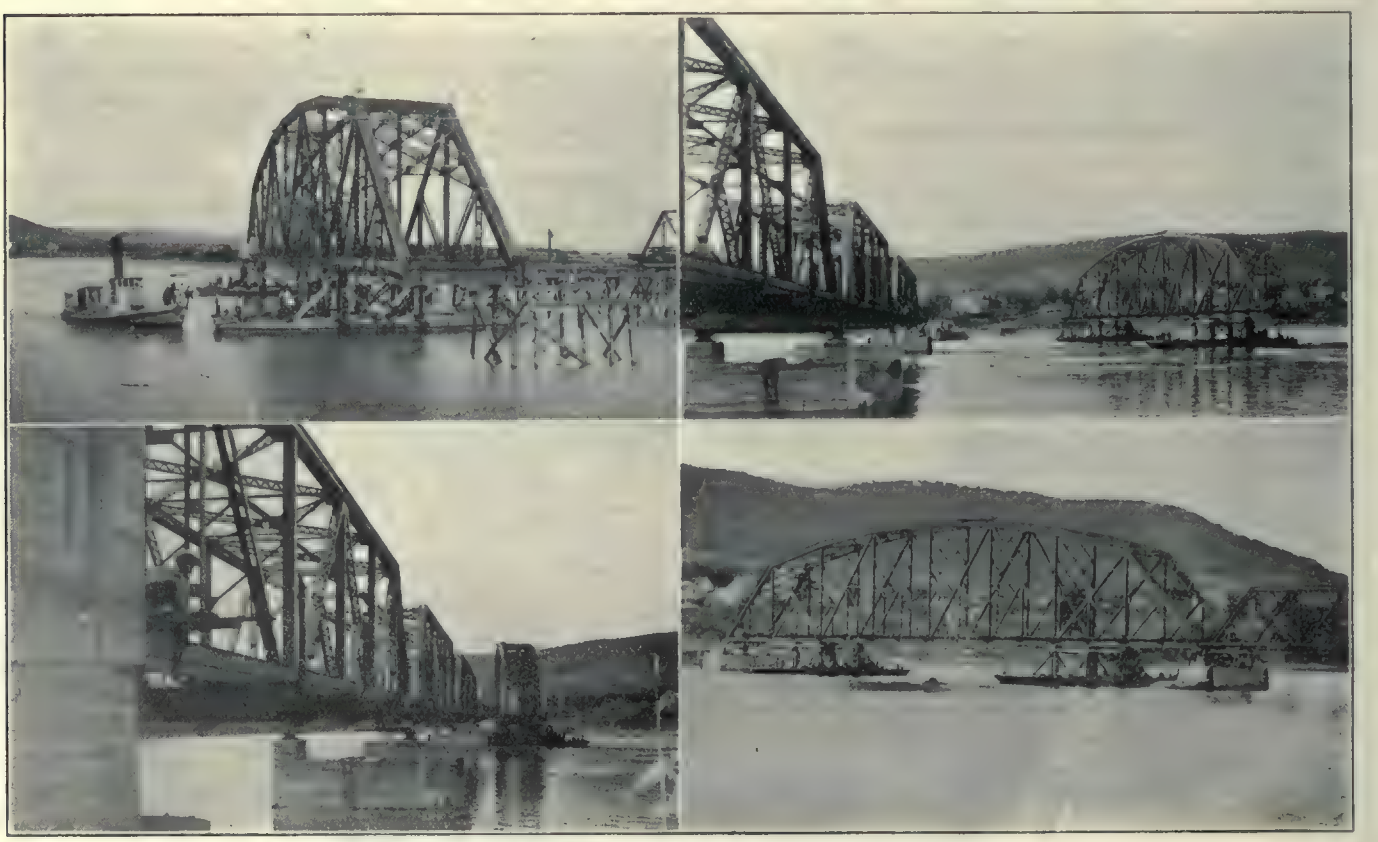


Fig. 12—Showing different views of the 294 ft. span being floated into place

Spans Unloaded on Pedestal

In all but two cases the spans were unloaded directly onto their pedestals. This includes the swing span, where the centre bearing was "made" perfectly as the tide fell, although the current at this point, and at the time when the span was unloaded, was very considerable. The exceptions were the two spans nearest shore on the Granville side, where, owing to the shallowness of the water, it was necessary to get the scows clear as quickly as possible. These spans were unloaded on blocking, in proper alignment, and subsequently jacked down.

The levels of the trestles and the falsework on the scows were arranged so that the scows could be moved under a span resting on the trestles on a rising tide and would float the span clear of the trestles about three-quarters of an hour before high water. After depositing the span on its bearings on the piers, the scows would be clear about the same interval after the turn of the tide. The start from the trestles was timed so that the destination would be reached at high tide, the passage requiring an average of half an hour. Even at this short time before high tide the current was very strong. In the case of the swing span it was necessary, on account of the upstream rest pier, to place the span almost exactly opposite its destination and upstream from the rest pier, and then drop it downstream, the scows straddling the rest pier. With the scows set as far apart as practicable, there was only some two feet of clearance on each side of the rest pier, which rendered the operation rather delicate.

No tow-boat was employed during any part of

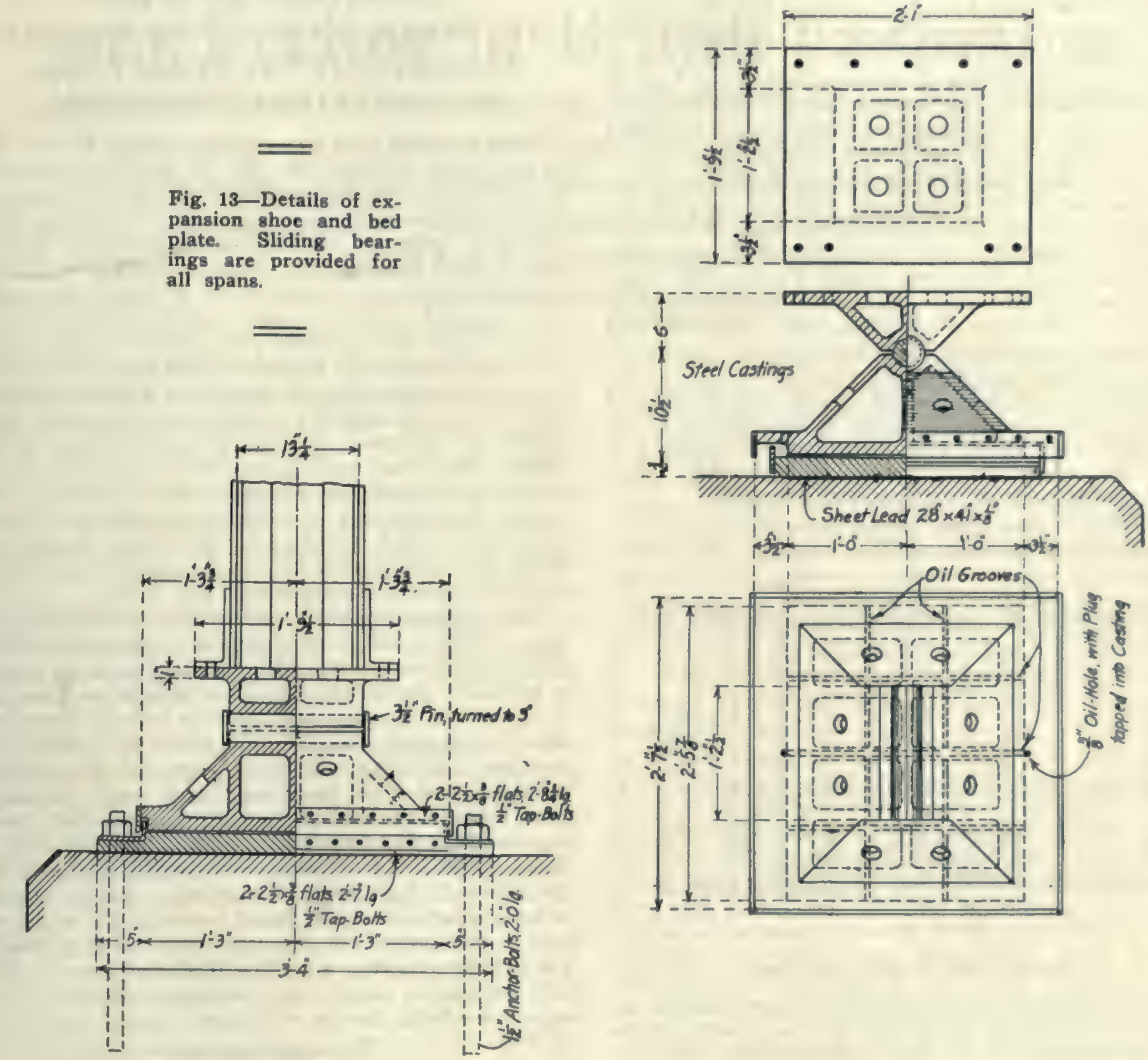


Fig. 13—Details of expansion shoe and bed plate. Sliding bearings are provided for all spans.

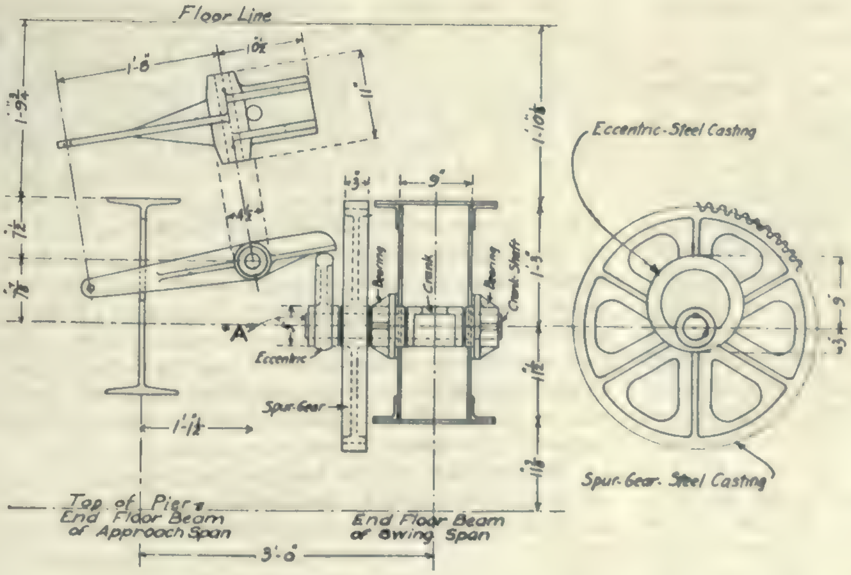


Fig. 14—Details of operating lever for safety gates on the approach spans.

the work. Two small gasoline launches were used to send out from the scows the ends of lines that were shifted during the crossing. One attempt was made to use a steam tug for this purpose, but the larger vessel could not manoeuvre quickly enough in the strong current.

The general scheme of erecting the spans had to be varied somewhat in the case of the 294 ft. span, on account of its weight. The trestles were designed sufficiently strong to carry any of the small spans and the middle four main panels of the long span. This portion of the long span was erected on the falsework on shore and moved to the ends of the trestles. The remaining two panels on each end were erected on light falsework bents. This work could proceed only at low tide, when the material could be moved out over the tidal flats. The stringers and some of the top laterals were not assembled until after the span was in place on the piers.

Erection was commenced about the middle of June, and was completed in the third week of October, 1921. The erection scheme worked without a hitch. The work was in charge of Mr. S. B. Edey, with Mr. David Bell, erection superintendent, supervising. Robert W. Hunt & Co. inspected both the fabrication and erection of the structure, the writer being their representative on the field work. The engineers of the Highways Board were in charge of the substructure, and of the laying of the floor. Mr. W. D. Robertson, A. M. E. I. C., was the resident engineer on this work.

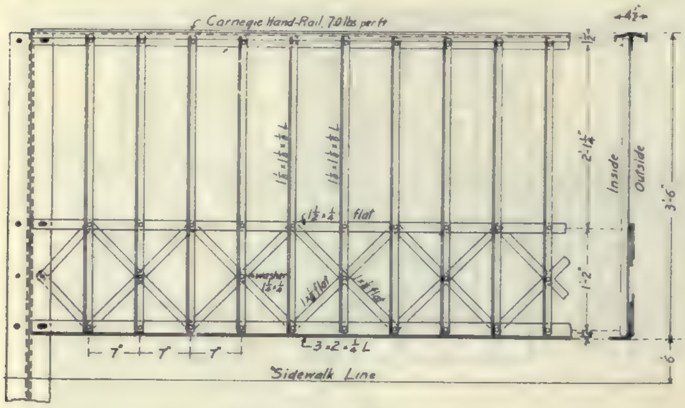


Fig. 15—Details of fence (inside view)

Two gasoline-driven road rollers have been purchased by the Dominion government for use in the Canadian National Parks system. One 4½-ton roller will be shipped to the superintendent of the Yoho and Glacier Parks at Field, B. C. The other, of 6½-ton weight, goes to J. M. Wardle, consulting engineer of the Canadian National Parks, at Firlands, B. C. These rollers are not new in Western Canada. Two of them have been in use by the city of Winnipeg for the past eleven or twelve years. They are manufactured by Barford & Perkins Ltd., of Peterborough, England, who are represented in Canada by Ed. O. Herbert, 81 Walnut Street, Winnipeg, Manitoba.

The Dominion Water Power Branch of the Department of the Interior has recently issued Water Resources Paper No. 28 covering hydrometric investigations in the province of Ontario. The paper is by S. S. Scovil, district egineer of the Water Power Branch.

Skilled Workmen Needed on Concrete Bridges

The Damage and Subsequent Repairs to Comparatively New Bridge Emphasize Need of Good Workmanship

The damage and subsequent repairs to the Mill Street bridge in Danville, Ill., is one more example of the extreme care necessary in the construction and design of large concrete bridges. It is becoming more and more apparent that it is not sufficient to have only a good construction superintendent on the job but skilled laborers are necessary to insure the proper selection and mixing of the ingredients of the concrete. While the specified proportion of sand, aggregate and cement may have been put in a piece of concrete, if the aggregate and sand have not been selected with great care and the whole mixed together thoroughly, a very poor quality of concrete may be the result. This was noticeable in the spandrel columns of the above mentioned bridge which were of a decidedly poor quality due either to the mix or the spouting methods employed. This fault would very likely have been avoided by the use of laborers skilled in this branch of the work.

The bridge was built in 1915 and consisted of nine spans. The arch ring, spandrel columns and cross girders were reinforced with four angles laced together in pairs. In 1918 cracks were noticed in a number of places and as time went on they became larger and more numerous till the safety of the bridge was menaced. An examination followed and it was found that the east end span was very badly damaged. Cracks had developed in the arch ring near the springing line and the spandrel columns had practically all failed. The cross girders were badly damaged and the sidewalk brackets had numerous cracks in them. A large crack was also found between the wing wall of the abutment and the approach wall measuring 1 1/8 inches at the top. The deck had moved about 2 inches at the face of the abutment so that 7/8 inch must have been due to expansion.

Improper Bearing

The movement of the abutment was evidently caused by the fact that not enough care was taken to secure a horizontal bearing on the shale as the examination found the bed inclined and part of the footing resting on coal 3 feet thick immediately above the shale. There was no provision made to take care of the seepage water behind the walls and this may have helped the movement of the abutment as a considerable amount of water was found retained.

The quality of the concrete was undoubtedly one of the causes of the damage for it was found to be very poor in all but the arch rings and a very generous coat of neat cement had been applied apparently to cover up its defects. This was noticed particularly in the columns which were lacking in mortar due either to a mix lean in sand and cement or more probably to separation while chuting into place.

All portions of the bridge that were badly cracked or had failed were removed and replaced and the abutment was tied together by steel-and-concrete ties to prevent further movement. Expansion joints were provided at each end of the span and drainage holes were bored through the abutment wall to insure future drainage of this part of the structure.

"Confident Uncertainty" is the Prevalent Feeling in British Columbia

Little of the Kind of Optimism that Characterized the Past— Rather, Uncertainty as to the Immediate Future but Confidence in the Ultimate Success of the Country—Construction Confined to Essentials—Impediments to Rapid Recovery—Need for a New Point of View

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

Three full years have passed since the close of the great war, and the changes they have brought are in their way perhaps quite as extensive and as unexpected as those which developed during the course of the war itself. Forces were unchained, indeed, during that time of upheaval, the strength of which had been gathering for decades, and whose far-reaching effects are as yet difficult of forecast even by those who make a study of economics, and which certainly are not understood by very many of those engaged in the various branches of the construction industry—among whom I include not only the engineering profession and contracting interests, but also the workers, broadly classed under the heading of "labor."

Not that anything very new has happened, the old problems of trade, of capital and of labor remain, but in a greatly intensified form, with more at stake, although in certain parts of the world there are mutterings which cannot be ignored, presaging trouble of a nature unknown for centuries— the bitter struggle of race against race and religion against religion. I make no apology for mentioning these larger issues in an article which is presumably limited to a consideration of British Columbia's prospects in the immediate future for the construction industry. The fact of the matter is that it is necessary, to a degree hitherto unprecedented, to take the wider view in the consideration of almost any public question, to see not alone a province, but also the nation of which it is a part, and to look even further afield for the underlying causes of local conditions and to some extent at least include in our view the world at large. For in these days of the wireless, the cable and rapid transit, the world has become relatively a very small place indeed.

Confident Uncertainty

There is to-day in British Columbia little of the kind of optimism of which one heard so much even a year or two ago—the idea that we could, so to speak, go back to the ways and conditions of the prewar years and carry on from there as if nothing had happened. At the same time there is little of discouragement in spite of the undoubted difficulty which many find in remaining in business at all; instead there is a feeling of what one might characterize as confident uncertainty—confidence in the ultimate success of the country, and an uncertainty as to what the immediate future holds which is perhaps hardly surprising when we recollect that the era of declining prices upon which we are now entering is a new thing in the experience of all but a few of the older business men. A majority of the men in business to-day were trained in the years succeeding 1897, when the previous era of downward trending prices ended and was succeeded by the period of mounting prices which ended at the beginning of 1920.

Construction Confined to Essentials

The actual construction program for the ensuing year seems to be confined to essentials, although the decline in the prices of lumber has had the effect of encouraging the building of residences to a certain extent. This has been chiefly the case so far as houses of the better class are concerned, but there has not yet been much revival in the building of the four, five and six room houses of moderate price which are so much needed.

Of the larger works, under public or government control, practically all are matters of prime necessity, either for conservation purposes or for the promotion of trade. Among these, perhaps the most outstanding from the engineering point of view is the Sumas reclamation scheme, which has been under way for over two years and will not be finished until 1923. This work is largely one of dredging and dyke building, and will effect the reclamation from periodic overflow of a large area of farm land. The provincial government has also recently let a contract for an addition to the mental hospital at Essondale for a sum in excess of $500,000.00 and is assisting with the construction of the new bascule bridge at Victoria as well as the extension of Johnson St. through the old Indian reserve to provide a new traffic artery from the city to Victoria West and Esquimalt.

Pier and Dock Development

The Dominion government has in hand the construction of the Ballantyne Pier at Vancouver, which is badly needed to accommodate the rapidly growing volume of ocean traffic to and from that port as the terminal of the three transcontinental railways of Canada. The government is also assisting by subsidy the construction of a dry-dock at Vancouver, which is being promoted by the Wallace and Coughlan interests, two of the principal ship-building firms of Western Canada. An order has recently been transmitted from Ottawa shutting down work on the dry-dock at Esquimalt, which was being built under contract for the Department of Public Works. It is not yet known whether the shut-down is intended to amount to abandonment or whether it is to give time for fuller investigation before a final decision is arrived at.

Among the private concerns the same policy of paring the construction program to the lowest possible limit is in evidence. Two of the lowest jobs in hand at present are the rebuilding of the town and the mill shed at the Brittania Mines, Howe Sound, B. C., which was destroyed by fire and flood last year, and the building of a large dam for power purposes at Anyox, B. C., for the Granby interests.

Unemployment Difficulties

Unemployment is still a serious problem, which is being partially relieved now (April) by the opening up of seasonal work on farms and in the lumber camps, etc. The cities have been carrying on a considerable amount of relief work, and have also been providing doles in some instances, while in Vancouver a camp was formed at the Hastings Park Exhibition grounds where single men housed and boarded and guaranteed two or three days' work per week. They were expected to use the free days in the attempt to find employment outside for themselves. Wherever assistance has been granted to relieve the hardships of unemployment the situation has been complicated by the unreasonable attitude of a section of the men assisted, who have made demands which could not be granted and have to a considerable extent alienated public sympathy. There are so many business and professional men with a problem of their own on their hands due to the same depressed conditions of business generally, that there is little tendency to exercise patience with men who have been assisted through the winter and who continually agitate for the payment of union wages and for changes in "conditions" which, if acceded to, would practically end in the agitators becoming a public charge without the responsibility of even seeking for work. And it would seem that there is little hope of a general and satisfactory increase in the amount of work offering until labor generally makes up its mind to accept reductions in wage scales all round, commensurate with the reductions in the cost of living and with the drop of prices of materials of construction, which cannot take the whole burden of the reduction of building costs which is necessary before any extensive program of work opens up.

Taxation is an Impediment

Taxation in some of the cities has reached a point where it amounts to practical confiscation of property, and as a result a great deal of both improved and unimproved property is being allowed to revert to the municipalities. This is occuring through properties being offered at auction for non-payment of taxes, the bulk, for lack of other bidders, being bought in by the city itself for the amount due. Of course, the condition is by no means ameliorated in this way, as the taxes on lands reverted have to be met by the municipality itself, with the result that the burden falls with increasing severity on the remaining property holders who pay the bulk of the taxes making up the general revenue. A vicious circle is thus instituted which, unless a halt is called, will end in bankruptcy and which in the mean time is operating to further reduce the building programmes, especially in the case of business and industrial projects which must show profitable returns from the investments.

Provincial taxation is also increasingly heavy, due to the constantly mounting costs of administration as well as to the construction projects to which the government is committed for various reasons, chief among which in point of expenditure is the Pacific Great Eastern Railway. That administration costs are increasingly high is due in part at least to the character of the settlement of the province, which has become so widely scattered as to necessitate the maintenance of an administrative organization which would serve the purposes of a population many times as large as the actual numbers as given in the figures published as the result of last year's census—523,369, of whom 297,521 reside in cities and the balance, 225,848 make up the rural population.

The Pacific Great Eastern Problem

The Pacific Great Eastern Railway is a very serious problem to the government also. As is fairly well known, the road was taken over from the original promoters some years ago to protect the bond-holders, the bonds of the company having been guaranteed by the provincial government. The indebtedness at that time was about $20,000,000 and the government was faced with the necessity of completing the road to its objective, Fort George, as well as shouldering the existing debt. This work, which is still incomplete, plus deficits on the operation of the completed section of the line has practically doubled the debt, so that this one item is in itself a serious burden on the comparatively small population of the province.

Oriental Competition

The question of Oriental competition is a very live one at all times in British Columbia, and has recently come very much to the fore again through the recent finding of the Supreme Court of Canada, which ruled that the legislative enactment of the B. C. government forbidding the direct or indirect employment of Oriental labor on government contracts is ultra vires of that body. As time goes on this problem is becoming increasingly serious as certain industries are monopolized by Chinese and Japanese to the entire exclusion of British residents, while the field thus threatened is constantly widening. During the last year or two, for instance, a brisk trade in lumber has grown up with Japan. This is not expected to be a temporary outlet for B. C. lumber as native lumber is becoming scarce in Japan and a permanent business is expected. Latest reports are, however, that Japanese interests are negotiating for large timber tracts on the west coast of Vancouver Island, which they intend to work with imported Japanese labor. This is only one instance of a number in as many fields of work, but serves to illustrate the seriousness of the situation from the point of view of the British and native-born Canadian.

The Bright Spot

The above statement of the facts of to-day in British Columbia sounds like a recitation of difficulties without a single bright spot, and I am afraid may earn the indignation of optimists who decry everything that is not on the surface a "boost." The bright spot was spoken of at the beginning of this article, however, and is the fact that in spite of all difficulties there is practically no discouragement—we believe in the country and know that it is good. Difficulties can be overcome and it is in the overcoming that men grow strong.

Need for a New Point of View

British Columbia is faced, in common with many other parts of the world, with the need of an entire change in her point of view. This perhaps sums up in a sentence the outstanding feature of the complication of conditions which at present affect the engineering profession and the construction trades. I referred above to the change which occurred when in 1920 we passed over the peak of the period of rising prices and started on the downward glide which, if history repeats itself, is likely to continue for a good many years to come. While this movement is not likely to continue in as violent a degree as it commenced, and will become more gradual as the proximate "bottom" is neared, whatever that may be, yet, as I said before, a movement of this kind is strange as a fundamental of business life to many if not most of the business men of this generation, whose whole experience has been built on a set of conditions in which prices were continually rising. Comparatively speaking, it was easy to make money under those conditions, provided one had a little to start with and could sit tight and watch it grow overnight, so to speak, without much personal effort and somewhat as the working out of a law of nature. And the working man, "labor," found it only necessary to combine in a demand for higher wages to find the demand met by acceptance of his terms, or at least by a more or less satisfactory compromise, until he too began to feel, in the parlance of our American cousins, that "the sky's the limit."

B. C. as an Investment Field

Again, it has been the habit for many years to point with pride to the immense natural resources of the country—to descant upon the vast areas of agricultural land "waiting only the settler's axe and plough"—the "stores of minerals in our mountain ranges" and so forth. And for years on the strength of these "potentialities" money flowed into the country for investment, much of it going into engineering works in cities, some into mining developments (both bona fide and hopeless,) and some into railway and miscellaneous projects. May it be said, with all due respect to those immediately concerned, that to a certain extent, albeit quite unwittingly, the people of British Columbia broke faith with these investors. The investors expected profits, naturally, and their security, whatever might be stated in the instruments, was yet in fact that of the **developed** resources of the country, the existence of which assets in an undeveloped state made this an attractive field for investment. In other words, those who were induced to invest money in the country on the strength of the potentialities it holds were entitled to expect some definite and progressive program of development on a scale commensurate with the possibilities.

Money Availability

With the breaking of the boom in 1913, the flow of capital from overseas abruptly ended. The was intervened and normal life and development was at a standstill until 1919, the promoters of public works then turning their eyes to the United States for funds, which in the depreciated state of international exchange were fairly easily acquired on the security of government bonds. Private enterprise, however, except in certain industries, and municipalities found difficulty in obtaining money from any source, the exceptions noted being of course, industries for whose product there was an active and promising market. This difficulty has continued and shows symptoms of extending its scope, as the provincial government has on several recent occasions found difficulty in satisfactorily marketing its bonds. That this condition is not due to any shortage of money at the source need hardly be said, and it follows that the cause is to be looked for at the investment end, in some condition or set of conditions which make investment doubtful or satisfactory. That no doubt exists in the minds of investors as to the actual profitable possibilities of the province, both as to natural resources development and from a manufacturing and commercial standpoint, is evidenced by the numerous enquiries which are constantly received at the offices of the boards of trade relative to establishment of branches and industries, and eventual prosperity seems assured. The cause of stringency then must lie at the door of the only remaining factor, namely the human element, represented by the promotors of works, the engineers, and labor. The attitude has already been mentioned and as this side of the question has a definite bearing on what seems to be necessary for the future, I must sketch, although very briefly, the position as regards the other two classes concerned.

Cities Over Developed

To put the matter in a nutshell, the tendency of those charged with the promotion of development schemes, particularly with reference to government and municipal works, has perhaps been to put the emphasis on providing the tools and facilities for development rather than concentrating on the actual development of natural resources themselves. To an extent this is unavoidable, and good business, of course, but taken as a whole the result has been that, comparatively speaking, the cities are overdeveloped and the parts of the province containing real wealth are, many of them, still to all intents and purposes inaccessible. It has for long seemed to this writer analogous to a policy which would build a large factory equipped with all the most modern devices without having previously given serious thought to the supply of raw material or to the state of the market about to be offered a manufactured commodity.

Something Wrong with the Engineering Profession

There is an impression steadily gaining ground that there is something seriously wrong with the engineering profession. The servants and advisors of both the previous classes, the investors and the promoters, they have not the full confidence of either. The trouble seems to be in the fact that so many of the men in the profession belong to that type from which inventors spring—contrivers in fact, loving the work for its own sake and revelling in intricate problems of mechanics. That these are required goes without saying, but it is also necessary that some at least of the men trained as engineers should be, first and foremost, economists in the broadest sense. It used to be said of engineers that they are the men "who can do with one dollar what any fool can do with two." The economist engineer of the future will make more profit for his principals with the one dollar than a purely technical engineer could, because he has kept in view the commercial side of the venture as well as the technical features, and has so adjusted his expenditures as to obtain the greatest possible percentage of return for the investment.

A Forecast

It is difficult, of course, to make forecasts as to the future trend of development work, but it would seem naturally to be based on three main features.

These are the immense timber stands, both of structural timber and pulp wood, the great mineralized areas, which in spite of a few large developments, have hardly been scratched as yet, and the fact that as the western sea-board province, British Columbia is Canada's gateway to the markets of the Orient, of Australia and New Zealand, of western South America, and is for certain parts of the prairie provinces the logical outlet for grain shipments to any foreign market. Each of these fields embraces within itself a great variety of opportunity both for engineer and builder. It would greatly exceed the limits of space to go into details on this point, and I will only mention two instances which illustrate the trend of the times. A wide field is opening for the electrical engineer in the logging and milling industry. Electricity is being applied not only in the mills but to the actual logging operations and railroads as well, this, of course involving considerations of waterpower as well as the actual electrical features. Similarly, the road engineer is likely to come into his own in a larger way than ever before. The evolution of transportation methods seems to be headed for a system in which the railroads will handle principally main line traffic, with branch line work more and more taken over by fleets of motor trucks.

Need for Hard Work

And in conclusion, what? We are waiting, a good many of us, for times to improve, for more work to be offered, for easier money and what not. Times are improving and money will be easier, but it will be very much in proportion as we recognize the changed conditions and "govern ourselves accordingly." We could afford to wait while prices were rising—investors were falling over each other to get in before they rose any higher. Now it takes salesmanship to persuade them to build, rather than to wait until prices are lower still. The time for waiting is over it would seem and the shirtsleeve policy reigns, for with prices on the downgrade profits are far more the result of personal effort and hard work than due to fortunate speculation.

A Volume of Business in Excess of Last Year's Anticipated in the Maritimes

An Aggregate Building Program of at Least Normal Proportions may Confidently be Expected—Several Promising Features in the Industrial Outlook are Discernible—Public Expenditures Will be Lower but Money is Fairly Plentiful for Commercial Purposes

By The Contract Record's Maritime Provinces Correspondent

The year 1921 is considered to have been about an average year as far as the building and engineering in the Maritime Provinces is concerned. The abnormal activity which had prevailed in 1918, 1919 and 1920, due, in the main, to war conditions, the Halifax reconstruction and large federal undertakings, had subsided. The general business depression which prevailed over practically the whole year, coupled with the high cost of labour and material, interfered seriously with industrial development and to a lesser extent with business and residential construction. That the total for the year kept as high as it did, was due in part to the development work of the provincial government departments, notably the power commissions of Nova Scotia and New Brunswick, and the highway board of Nova Scotia.

Smaller Expenditures This Year

Conflicting factors influence the prospects for the coming season. On the one hand, there is the reduced activity of the two power commissions, whose initial projects, involving a total expenditure exceeding $4,000,000, are practically completed. There will also be a smaller expenditure on provincial highways.

The New Brunswick Electric Power Commission is just undertaking the construction of a high tension transmission line from St. John to Moncton, involving an expenditure of somewhat less than $500,000. There is still some work to be done on this Commission's development at Musquash, from which both S. John and Moncton will be initially supplied with electrical power and energy, including an extension of the transmission line from the existing substation on the outskirts of the city, where the connection will be made for the Moncton line, to a point more centrally located with respect to the distribution system in the city of St. John. Numerous requests for power are being received and it is probable that during the present year, preliminary arrangements will be completed to undertake one or more hydro-electric developments of considerable magnitude.

The Industrial Outlook

In the industrial field, lumbering continues dull, with not a very encouraging outlook and the coal and steel industry is in a somewhat unsatisfactory condition. The labour trouble in the coal mines, although it has passed the acute stage of a few weeks ago, is not yet settled. It is possible, however, that if this difficulty is satisfactorily met and miners evince a tendency to get to work, better times in this industry are just ahead, for the strike in the States will help the Nova Scotia mines to regain their lost market in Upper Canada. This strike has already manifested itself in a general stiffening of steel prices, a fact which is not without its significance for the Nova Scotia steel industry.

On the other hand, there are several promising features discernible. There is no doubt that the demand for residence construction has become acute and the prohibitive labour and material costs of the past few years, which are responsible for the shortage, have improved. Furthermore, the general business outlook is brighter. High priced stocks have been disposed of and all along the line from consumer to manufacturer the prospects are for a reasonably steady demand. In at least two industries, which affect the buying power of considerable portions of the population, namely, the fishing and farming industries, the prospects are bright. The early spring trip of the fishing fleets has been successful, the Lunenburg banking fleet, alone, having returned with over 40,000 quintals, which command about double the low price of last year. The apple growing and general farming district are expecting a year at least as good as last and in this connection it may be said that the return to one agricultural group, the Annapolis Valley farmers, on their apples alone last year, was appoximately $4,000,000. The very satisfactory conditions in the Annapolis Valley during the past year, with its widespread depression, has been one of the bright spots in the whole of the Dominion of Canada, and on the trains and elsewhere, one frequently heard comment on this situation by travelling men.

Signs of Revival

The general revival of business cannot fail to effect favorably the building and engineering situation, although in what degree it is not possible to say. Certainly industrial construction, which was almost stagnant during 1921, should show some signs of revival.

Money seems to be fairly plentiful for commercial purposes. Several local municipal bond offerings have been quickly absorbed. It is well known that there has been a general rise in the price of well established securities and the lower yield available will probably interest the public in new issues for commercial purposes, with the prospects of greater return.

On the whole, it may be said that although there is no indication at the present time of any marked activity, yet a general volume of business in excess of last year and an aggregate building program of at least normal proportions may confidently be expected.

Signs of New Life Are Evident in the Construction Business of the Prairies

A Survey of the Building Situation in the Chief Centres of Manitoba, Saskatchewan and Alberta Leads to the Conclusion that the West Will Make a Splendid Showing this Year—Many Cities Anticipate Large Programs of New Building

The depression in general business conditions which has been felt throughout Canada during the past few years was probably more marked in the prairie provinces of Manitoba, Saskatchewan and Alberta than in any other section of the Dominion, due to the large extent that general business activity in that section depends upon the one and all important industry of agriculture. In other parts of the Dominion, where the industries are more numerous, a slackness in one branch of industry is not so keenly felt in the general business situation.

To summarize in a phrase the general opinion of several of Western Canada's foremost business men, as to the business outlook for the immediate future, it is generally felt that although conditions throughout the country might at this time be more active, industries with few exceptions are making excellent progress and this progress should be accelerated, so that by the end of the year business should have more closely approached the condition of "normalcy" than has been the case for the past several years.

The financial situation is in excellent shape. The banks are carrying large sums in their savings accounts and are prepared to look after the requirements of any deserving business. Stocks, in general, are low throughout the country and the public are becoming slowly convinced that prices in practically all lines have reached the lowest level possible. In many cases present day prices show a much smaller percentage of increase over the 1914 level than does the relative labor scale for these respective periods. The big consumer of the Western Country is the producer and as he is enjoying better prices for his grain products at the present time than he has for several months past—in fact, experienced a loss on his sales for some time—this readjustment of the situation is bound to result in a revival in buying and therefore better business.

The west is practically at the turn of the road and all indications point to a rapid recovery from the effects of depression. Doubtless it will be slow at first as time alone can establish that general feeling of confidence essential to successful business in all branches of all industries. There are many lines, no doubt, that are at present selling below their manufactured cost, while on the other hand there may be some that could stand considerable reduction. These will, it is anticipated, readjust themselves during the course of the present year and result in the stabilization of industry in general.

The summer season will probably bring about a slight slackening up of business activity. This is to be looked for, and happens in normal times. However, by the fall again business will pick up and proceed, doubtless, at a greater rate of speed than the present season is indicating.

There is every reason to believe that the wide-awake manufacturers and dealers who look ahead and plan, buying and selling carefully, should realize a profit on this year's business.

The part that construction will play in the return to better business will be a large one as indicated by the reports of several of the larger cities in this district. A review of the program planned throughout these various centres follows:

Building in Winnipeg, though the question of reductions in wages must necessarily effect the situation to some extent, is considered likely to be very fair during the 1922 season, though not of that magnitude which was expected at the beginning of the year

Building material has shown considerable reduction since the opening of the 1921 season, and wage schedules also show reductions. The shortage of houses at the present time exceeds even the startling figures which were shown by the survey of the situation made last year. Business firms have for several years delayed building owing to excessive costs. Each year has added during that period to the number of firms whose premises require expansion to cope with their business, and notwithstanding the recent depression of trade, steps must be taken to prepare for the recovery, and buildings for industrial and warehouse purposes cannot be provided overnight.

Costs show signs of coming down in both wages and materials, so that there is less incentive to delay in building this year than for several seasons past.

Edmonton's Prospect Good

From Edmonton comes the report that prospects for building in 1922 are good. The city plans to spend about $150,000 on sewer and water extensions, and about $15,000 on sidewalks. For electric light and power, high tension feeders will involve an expenditure of $50,000, and extensions $15,000. Telephone extensions will take $80,000, and a by-law for the expenditure of $170,000 on a new telephone exchange and equipment is to be placed before the people for construction this year. With the exception of the telephone exchange and equipment, all the above work is definitely passed, and construction will commence as soon as weather conditions are favorable. Other work is planned, but not yet passed.

The labor situation in Edmonton is easy. There is no scarcity of either skilled or unskilled labor. Wage schedules are not yet decided, but slight reductions are anticipated. Present prices of material and labor are not interfering with the undertaking of construction.

Saskatoon reports prospects for 1922 building good. On roads $16,000 will be spent; sewer and water connections, say $30,000. A high school, costing $100,000, is to be erected; and hospital improvements will cost $30,000. Extensions to the street railway, waterworks and electric light and power departments will cost $75,000. Business buildings to be erected this year are estimated at approximately $300,000; and about $450,000 will be spent on residence building. In addition, the provincial government is spending $500,000 on a chemistry building for the Saskatchewan university in the city.

Prince Albert reports that some $500,000 will be spent in building in that city in 1922. Civic activities in this line consist of ordinary maintenance of roads and gravelling of two miles of streets. Of public buildings and government work, the principal undertaking is the completion of the provincial jail at an estimated cost of $300,000. Residence buildings, to the aggregate of $75,000, are anticipated, with $50,000 to be spent on stores, offices, etc.; miscellaneous, $75,000. The labor situation is reported as well balanced, and wages as no hindrance to ordinary construction. There are sufficient houses for present needs, with the additional construction above noted.

From Red Deer comes word that quite a lot of building is contemplated, and much more than for some years past, though no figures are available as yet. The Canadian National Railway is building a station, freight sheds, turntable and stock yards; and the British American Oil Company is constructing oil tanks and warehouse. The Big Valley Coal Company is erecting coal sheds. No delay in commencement of work is anticipated, and it will proceed as soon as weather permits. Wages are based on those paid in Calgary and Edmonton, and there is plenty of skilled and unskilled labor to take care of the construction. Prices, which have been a detriment to building in past seasons, are said to be getting down to a reasonable basis this year. Modern houses are in demand, and there are not enough to supply it, but no housing scheme has been developed.

Regina reports that there is little activity in building construction so far, but considerable housebuilding is looked for as the season opens. The city has work. Labor of all classes is sufficient to handle any prospective construction work, but present wages and prices of material are having a tendency to retard building operations. Demand for housing is such that rents are kept at the peak, but no civic or governmental steps have been taken to relieve the situation.

Medicine Hat reports no information as to constructional activity, the city itself undertaking this year general maintenance only of public works. No reductions in wages for labor are expected, and there is no scarcity. Present prices are not proving any bar to commencement of construction.

Camrose, Alta., reports that up to the present there is only minor building in sight. Labor is not actively in demand, wage reductions are being made, but building material prices are not yet low enough to stimulate building. There is some shortage of housing, but no official steps taken to counteract it.

Fair Season For Lethbridge

Prospects for the construction season of 1922 are fair so far as Lethbridge is concerned. A fair number of residences are planned and some business buildings. A small amount of sewer, sidewalk and utilities construction will be undertaken by the city. The new library has just been completed. A reduced schedule of wages has been proposed and will undoubtedly stimulate construction. There is no shortage of labor. About 50 to 100 houses are needed, but no official steps towards meeting the demand are being made.

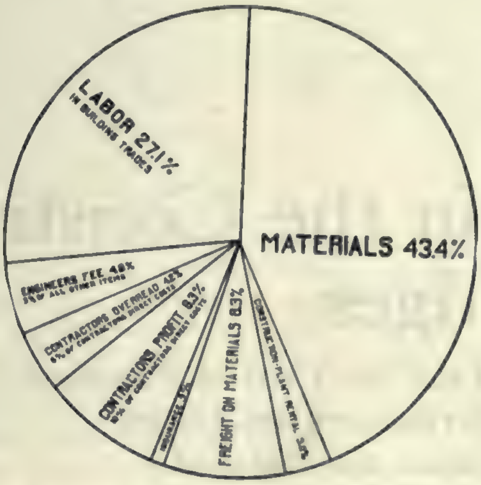
Estevan reports nothing definite in building line for 1922, and prospects poor so far as the town is concerned, but the considerable increase in coal production, and the probability of the opening up of new mines, may have a beneficial effect so far as the district is concerned. The city will undertake only sewer and water connection work this summer. The failure of crop during the past few seasons has hindered progress. Only the gradual growth of the mining community and the brick industries of the town make for expansion. The success of the lignite briquetting plant is considered the key to the growth of the dis-

(Concluded on page 464)

How Much Has the Cost of Factory Construction Dropped?

An Analysis of the Various Items Entering into the Erection of an Industrial Building Shows Substantial Reduction in Cost Over 1920 Figures—Distribution of Costs

How does the cost of erecting an industrial building under present day conditions compare with the cost two years ago, when materials and labor were at their peak? That is a question that contractors are being asked every day by prospective owners who are anxious to know if the time is now ripe to proceed with the erection of some structure that, perhaps, has been held in abeyance pending lower costs. To answer the question, the Contract Record has been investigating the trend in costs and to simplify the analysis, has selected an actual factory building on which tenders were taken in 1920 when prices were highest. A re-estimate of the cost of erecting the factory under conditions obtaining to-day has been made and the results set down in comparative form in the accompanying table.



Distribution of costs in an industrial building

In determining the cost index, the index figure of 1920 has been assumed as 200 for every trade. This, of course, is not strictly accurate but in general represents the relation of 1920 prices to those of 1914. There is so little data available that an accurate index number for each trade can hardly be computed. On the assumption, therefore, that 200 is the index number of each trade involved in the analysis, as of June, 1920, then the total cost index has dropped from 200 to 157.6, or 21.2 per cent. As seen from the table, the type of factory under consideration is a reinforced concrete building.

In analyzing the costs of industrial buildings, a chart such as that shown herewith is illuminating. It has been prepared by Monks and Johnson, engineers, New York, and shows the distribution of building costs under present conditions. The items are retabulated as follows:

Materials,	43.4%
Labor in building trades,	27.1%
Freight on materials,	8.3%
Engineer's fee,	4.8%
Construction plant rental,	3.0%
Insurance,	.9%
Contractor's overhead,	4.2%
Contractor's profit,	8.3%
	100.0%

The last five items fluctuate but slowly and that only as the cost of commodities in general rises or falls or as they are directly affected by the remaining three items of the chart, the effect of changes in which is outlined by the compilers of the chart as follows:

Labor. Wages of artisans employed in the building trades gradually rose from December, 1913, to a peak in May, 1920, and from that peak they have descended not more than fifteen per cent. But the efficiency of labor, which had fallen as wages rose, has returned to that which obtained in 1914. This is due pri-

Extension to Factory—Comparison of Estimates of Costs June, 1920 and April, 1922

Trade	June 1920		April, 1922		1920	1922	Cost Index	
	Material	Labor	Material	Labor	Totals	Totals	1920	1922
Excavation & drains	$ 250.	$5,445.	$ 246.	$4,387.	$ 5,695.	$ 4,633.	200	162.7
Concrete and masonsy	16,884.	8,863.	15,160.	7,052.	25,747.	22,212.	200	172.5
Forms for concrete	5,330.	8,210.	3,432.	6,746.	13,540.	10,178.	200	150.3
Reinforcing steel	8,550.	1,740.	6,525.	1,305.	10,290.	7,830.	200	152.1
Carpentry and millwork	4,956.	1,416.	3,771.	1,260.	6,372.	5,031.	200	157.9
Steel sash	1,430.	300.	1,002.	234.	1,730.	1,236.	200	142.8
Miscellaneous iron	1,784.	124.	1,345.	124.	1,908.	1,469.	200	154.0
Roofing and sheetmetal					2,382.	1,757.	200	147.5
Plumbing					3,378.	2,666.	200	157.8
Heating					16,265.	13,015.	200	160.0
Electric wiring					2,898.	2,300.	200	158.7
Painting and glazing					3,930.	2,880.	200	146.5
Lath and Plaster					3,353.	2,626.	200	156.6
Plant equipment & incidentals	1,825.	1,525.	1,223.	705.	3,350.	1,928.	200	115.1
General overhead & profit					12,340.	9,453.	200	153.1
					$113,178.	$89,214.	200	157.6

marily to the scarcity of work. As a result of this increased efficiency the cost of labor on buildings has probably fallen fifty per cent. from the peak of the war period.

Material. The price of materials depends upon the cost of production and demand. The demand for building materials has been so small during the last twelve months that it is probably true that in order to stimulate the market, materials have sold at a price leaving the manufacturer and dealer no profit, and in some instances have probably been sold below what it cost to produce them. The price quoted in the open market for building materials would not indicate that these sacrifices had been made, but contractors have recently been able to buy at prices far below market quotations. The cost of production is therefore not an important factor at this moment and in any event is likely to change but slowly. From this analysis of the market it would seem that no substantial drop in prices will occur within the next year, but that the seasonal demand likely to occur in the Spring will undoubtedly cause a stiffening of prices.

Freight. There is some talk of a reduction in freight rates, but a cut of twenty per cent. in this item would result in a decrease of less than two per cent. in the cost of building.

Conclusion. From the foregoing short discussion it would appear that the cost of building now is as low or lower than it will be at any time in the next year.

Equipment Rental

If there is anything justified in the way of a rental proposition for a contractor it is in the transportation equipment. This is the most variable and the hardest item to figure. Furthermore, it is the largest investment. There are many trucking concerns now entering the highway field which are often more capable of handling the transportation than the contractors themselves. This enables a contractor to use various methods in transporting his material, and, as is well known, the transportation is the hardest item to figure and the most unreliable.

Too many contractors allow machinery salesmen to plan their work and talk them into buying equipment which they do not need and cannot afford to own. That is, equipment that in the long run will not pay for itself. A contractor in buying equipment should buy only the equipment which he believes will be useful to him every year until its life has been spent. If he has a special job requiring special equipment, the writer believes it is better to rent rather than buy.

Distribution of Costs in the Construction of Bridges

Labor Charges Account for Nearly Half the Cost of Erecting Bridges—The Figures on Four Structures are Given to Show How the Various Items are Related

In the accompanying table is an analysis of cost data for four bridges. Three of these were completed immediately before the war and the other during and after the war. They represent three very distinct types of bridges, the first being a concrete beam bridge, including abutments and fill; the second and third being concrete truss superstructures only, and the fourth being an arch viaduct complete.

In the labor costs is included the entire pay roll of the contractor, but not inspection nor engineering charges. Gravel and crushed stone are figured as material at the site, no labor costs, such as hauling, being included in this item, except as it is handled after being placed at the site.

The analysis is extremely interesting in that it shows that the labor involved in building a bridge is almost 50 per cent of the total cost. This appears to be true whether the bridge is a $3,000 one or a half million dollar one. For the information given herewith we are indebted to Mr. Frank Barber, managing director of Frank Barber and Associates, Ltd., consulting engineers, Toronto, who have carried out a great deal of bridge work in various parts of the country.

Table Showing Percentage of Labor Cost to Net Cost of Concrete Bridges

Name	Year	Material	Freight	Labor	Total Cost	Salvage	Net Cost	Cost per cu. yd.	Labor % of net cost
Pine Grove (whole) 16 x 60 Beam Bridge	1913	1,930.30	82.02	1,661.24	3,673.56	165.00	3,508.56	11.82	47.3%
Eckardt (sup. struc.) 16 x 70 Concrete Truss	1913	1,602.59	38.76	1,499.79	3,141.14	75.00	3,066.14	39.34	48 %
Birrells (sup. struc.)* 14 x 65 Concrete Truss	1913	1,647.14	9.45	1,180.00	2,836.59	50.00	2,786.59	48.88	48.5%
Peterboro (whole)*	1919-21		3,482.84	249,205.43	524,379.86	24,089.67	500,290.19	35.10	49.5%

*Piled for centering.

Note: Gravel is considered material on the ground.

Recent Developments in Small Town Water Works Design

New Ideas in Pipe, Reservoirs, Machinery, Filtration and Specialties for the Average Water Supply Plant—Electric Drive Supplanting Steam—Gravity Filters Replacing Pressure Type—Other Tendencies Toward More Efficient Operation

By E. M. PROCTOR, A.M.E.I.C., M.A.W.W.A.
Of James, Proctor & Redfern Ltd., Consulting Engineers, Toronto

The commercial and industrial development of any country can be easily determined by studying the growth and construction of water works systems. The province of Ontario is no exception to this rule, and one can readily pick out the prosperous years by noting the larger sums spent on the construction and development of waterworks.

During the period from 1895 to 1905 there was a marked activity in the construction of new systems, nearly all of them being operated by steam power. Since equipment of this nature has a life of about 25 years, it will be readily seen that many of these plants now require replacement, and a great many require additional supply as a result of the steady growth of the community. Another feature that has accelerated replacement of equipment is the introduction of hydro-electric energy as a power supply for the pumping station. Generally speaking, when alterations are considered, the general condition of the whole system is investigated and necessary extensions to the supply system, reservoirs, etc., are undertaken at the same time.

It will be interesting to review a few of the changes that are taking place; and in order to be brief, the various items are listed under different headings.

Cast Iron Pipe

There has been only one development that has any mark of real progress in connection with the manufacture of cast iron pipe, namely the DeLavaud method of centrifugally casting water pipe. This method has been introduced in Canada by the National Iron Corporation during the last eighteen months.

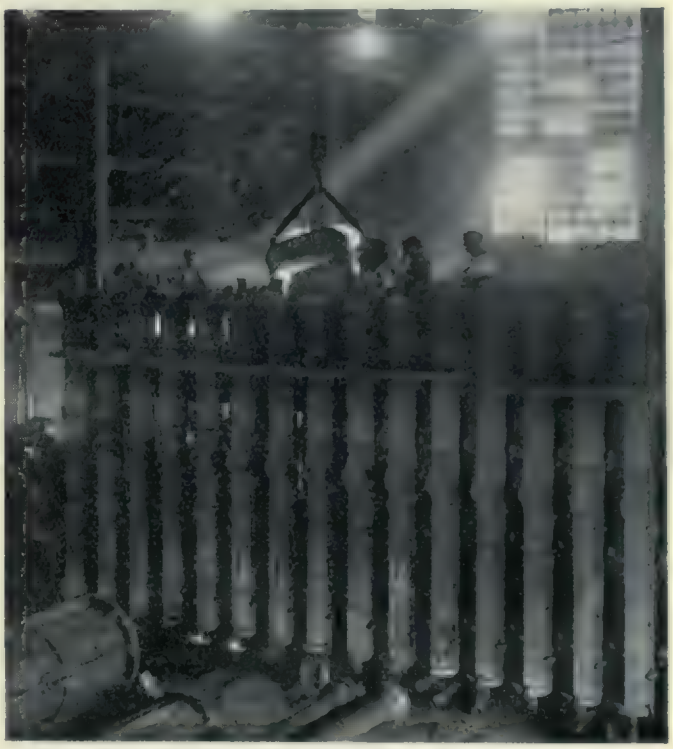


Fig. 2—Pouring metal for sand cast pipe

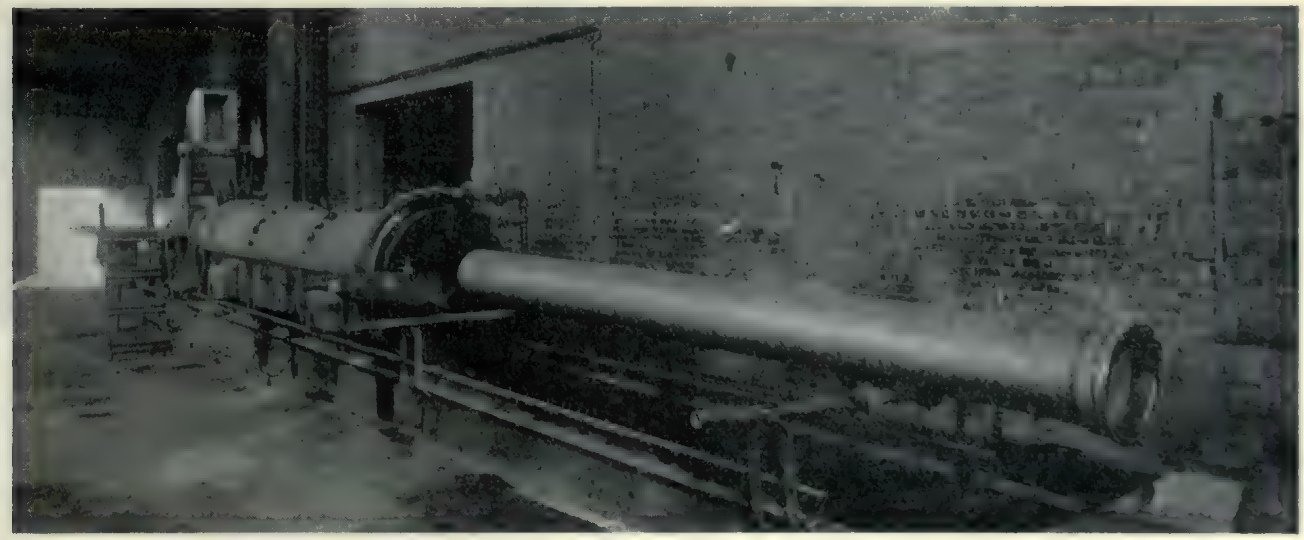


Fig. 1—The machine for the manufacture of centrifugally cast iron pipe (De Lavaud pipe) in the plant of the National Iron Corporation, Ltd., Toronto

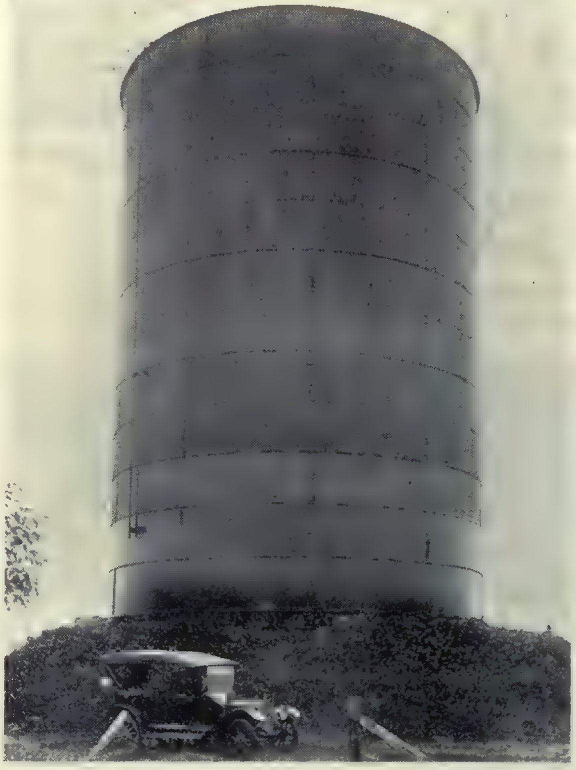
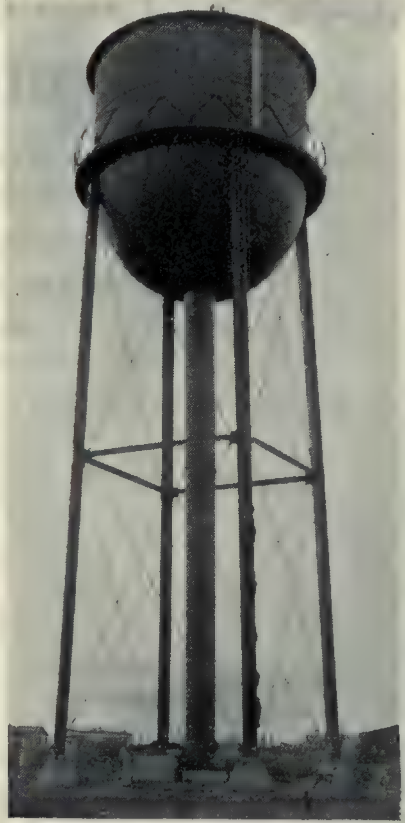


Fig. 3—(left)—The cylindrical standpipe which is being supplanted by the elevated type of tank shown in Fig. 4 (right)



Instead of casting the pipe in vertical flasks as is the standard practice, this company has developed a machine which casts the pipe in a mould centrifugally. Figure 1 shows the type of machine used and one can see at a glance that there is a great deal less space in the foundry used in the operation of this machine than in the old fashioned method, which is shown in Figure 2. Pipe of this kind is being placed on the English market by Starter Ironworks Company, in the United States by the Cast Iron Pipe & Foundry Company and sold by the lineal foot. It is a much denser casting than ordinary sand cast pipe, and has a thinner wall but has high tensile and shock resistance values and presents extraordinary resistance to corrosion.

Cast Iron Specials

The tendency in cast iron specials is to shorten the length and make a much lighter special than heretofore. There is also a special being put on the market that can be worked into a pipe line without the use of the ordinary sleeve which is generally called for when pipes are cut. These specials are not as well known in Canada as in the States, but no doubt, will become more widely known as the demand increases.

Reservoirs

The marked improvement in the construction of the overhead type of reservoir is perhaps one of the most noticeable advancements in waterworks engineering, particularly because the elevated tank is perhaps the real landmark of any waterworks system. The elevated reservoir, with hemispherical bottom, built up on columns has practically displaced the old fashioned cylindrical standpipe except in cases where special conditions exist. Figures 3 and 4 show these two types.

The introduction of reinforced concrete during the last twenty years has made it a much simpler matter for waterworks systems to construct large underground reservoirs. Consequently many towns have increased their storage capacity by the construction of such reservoirs. This to some extent has been due to the introduction of reinforced concrete but also to a large extent to the fact that municipalities are appreciating more and more the advisability of having at hand the proper storage of water to overcome the peak loads on their system and the possibility of fire demands which are ever present. Figure 5 shows the reinforced concrete reservoirs of Leamington, Ont., each one holding 500,000 gals. of water.

Fig. 5—Two underground reservoirs at Leamington, Ont.

Practically all inland towns of Ontario secure their water from underground sources of supply and the question of storage as the town grows is as important as any other item of the system. The problem of keeping water in storage in good sanitary condition has also received considerable study and the question of covering reservoirs from sunlight and controlling bacterial growth in open reservoirs chemically are perhaps two outstanding developments throughout Ontario during the last twenty-five years.

Buildings

The earlier pump houses were constructed of brick and timber. The more modern buildings today are constructed of brick and reinforced concrete, thus eliminating the fire hazard, which is a very serious consideration in connection with pump house construction.

There seems to be, however, in our modern idea of efficiency a tendency to crowd machinery into smaller space than hitherto, no doubt due to the fact that costs of construction have increased tremendously. As the costs become more normal, however, more space should be provided in the pump houses for equipment.

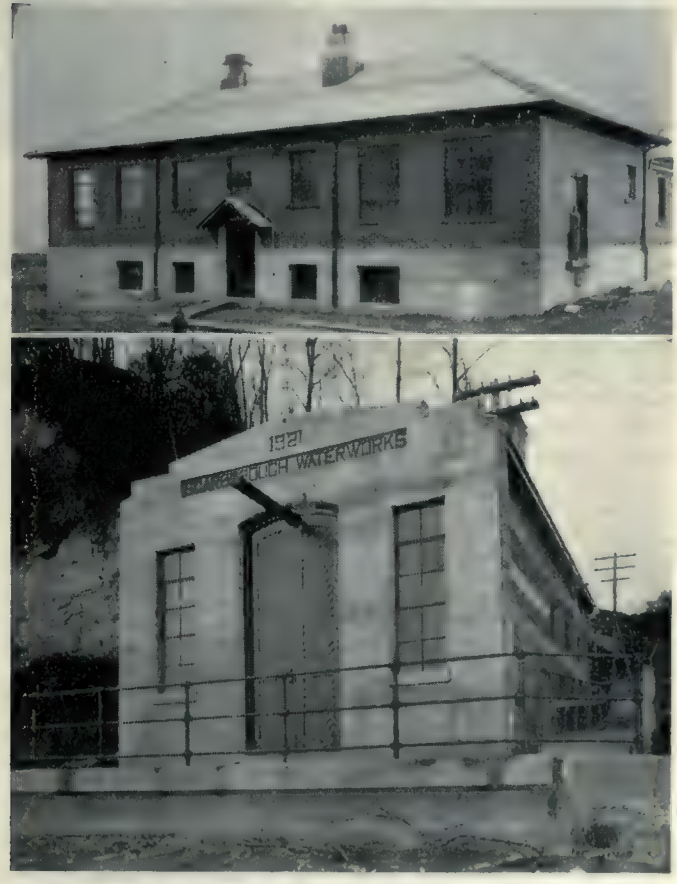


Fig. 6—Substantial buildings are now the rule in water supply plants. These illustrations show the filter house and the low level pumping station of the Scarborough, Ont., waterworks

Pumping Machinery

Perhaps in no other branch of waterworks engineering has there been such rapid strides as in the design of pumping machinery. With the advent of hydro-electric energy, it has been found very much cheaper to pump by electricity than by steam, and the motor driven centrifugal pump has very nearly eliminated the steam driven piston pumps of past years.

The installation of electrical equipment has made it necessary for municipalities to have alternative power units, due to the uncertain nature of electrical power lines. To provide this necessity, the high speed gasoline engine directly connected to centrifugal pumps has been developed and during the last few years has been brought to a high state of efficiency and dependability.

While the gasoline engine has a very high cost of operation, yet its capital cost is very much lower than any other type of combustion engine. The question of installing Diesel oil engines or semi-Diesel oil engines has been very often considered but the high capital cost of these units, considered with their small periodic operation does not warrant their installation unless for special reasons of service in addition to fire protection.

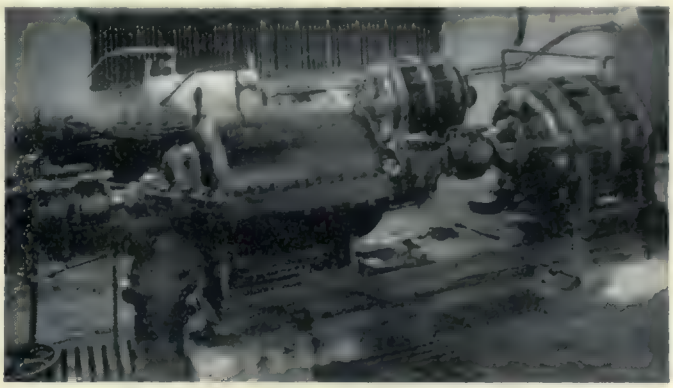


Fig. 7—An electrical pumping plant at New Toronto

There are several systems throughout Ontario which depend upon water power for pumping energy. The advances that have been made in the design of hydraulic equipment have produced some very neat and compact direct connected pumping units. Perhaps the most outstanding improvement in connection with this equipment is the compact reduction gearing which can be obtained for the connection between the shaft of the water wheel and the centrifugal pump. Figure 7 shows a modern electrical pumping unit installed at New Toronto, Ont., and figure 8 a gasoline engine unit at Napanee, Ont.

Filtration

The gravity type of filter is gradually displacing the pressure type. This is due to several reasons which have developed in operation. Unless a well designed mixing and feeding apparatus is installed and a proper coagulation period provided in a settling

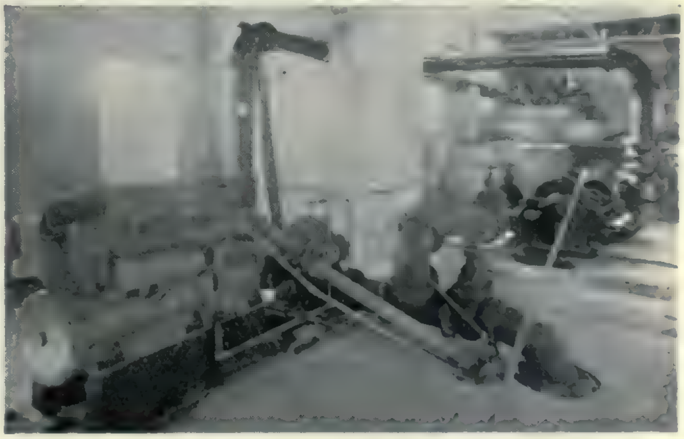


Fig. 8—An hydraulic pumping unit with gasoline engine reserve at Napanee, Ont.

basin with proper baffle boards, the load on the filter may be excessive. The application of the chlorine is necessarily before filtration because the water after filtration is under service pressure. In a gravity type plant, all these items are considered in the layout and design while too often the pressure filter has been considered a piece of equipment to be purchased and set up in the pumphouse without the necessary complementary equipment. Here again the question of cost often is the deciding factor.

The operation of the gravity filter is visual at all times and nearly all plants are equipped with rate controllers. Unless a large reserve of filter area is provided in a pressure installation and controllers installed, the plant is overloaded at times of peak load. In a gravity plant a filtered water reservoir is always provided and the peak load of the pumps is drawn from the reserve in the reservoir, thus enabling the filters to work at a constant rate.

A feature that is receiving more attention in the pressure plants that are in operation is the back wash. Experience has shown that it is very difficult to secure the necessary large amount of water to properly back wash pressure filter and to overcome this, in some of the newer installations, more than one point of wash water application is being provided.

The economic feature of only requiring one lift by the pumps in a pressure filter plant as against two lifts in most gravity type plants has been overcome to a large extent by the cheapness of pumping by hydro-electric power.

Both types have their place in filter plants but neither should be installed without competent advice.

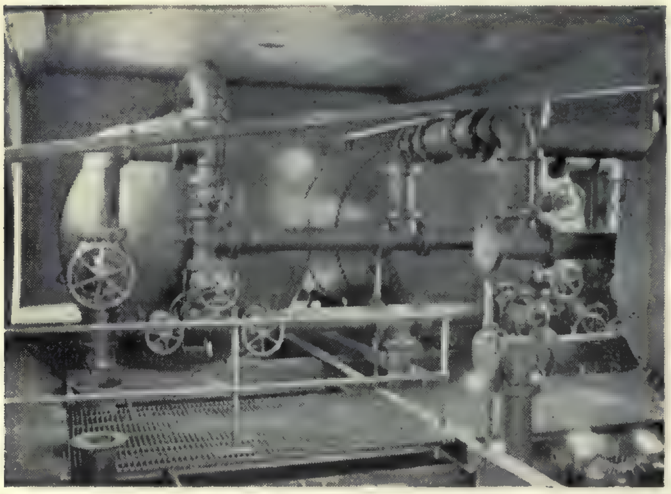


Fig.9—Pressure filter at New Toronto, Ont.

Figure 9 shows the pressure installation at New Toronto, Ont., and figure 10 shows one of the gravity filters in operation at Scarboro, Ont.

There has been a great advance in the last few years in the design of altitude valves, remote control valves, indicating meters, gauges, etc., and perhaps the most outstanding mechanical device which has been introduced is the liquid chlorine apparatus. These various pieces of equipment are of such common daily occurrence in all water works plants that it is not necessary in this article to outline the various details.

Construction Machinery

In the construction department, great developments have taken place, trenching machines, tractors, trucks, backfillers, caulking machines, oil burning lead pots, etc., have all found a place, to some extent, in every superintendent's pipe laying equipment.

While labor was so scarce and expensive, these mechanical devices were almost a necessity to get work done. To-day with plentiful labor and consequently cheaper and more efficient labor the tendency will be to use more labor and less machinery.

Fig. 10—Gravity filter recently installed at Scarborough, Ont.

Office Records

There is a growing tendency in all water works departments to adopt modern office record systems and place the various departments on a proper accounting basis. Water rates are receiving careful study and are being adjusted to produce more revenue. In this connection the agitation for the adoption of meters has found new impetus and a number of towns and cities are gradually metering all services. All new systems have been metered.

Administration

A large majority of the water works of Ontario are now administered by public utility commissions elected by the ratepayers. It is largely due to this change that so many necessary improvements are possible as the water works have been taken out of politics.

Signs of New Life Are Evident in Construction Business of Prairies

(Concluded from page 457)

trict, and this question will be settled one way or the other this summer.

Brandon reports there are no prospects of building activity for 1922. Possibly a few residences may be built. There is no scarcity of labor. Conditions have been too stringent to permit of many people taking advantage of the municipal housing scheme.

Little construction is expected in North Battleford this year. The city itself will undertake only general maintenance work. Modern houses are scarce.

Weyburn reports construction prospects for 1922 are not very encouraging. There is no new program in sight either for civic or government work. There is no scarcity of labor; wages are not any detriment to construction, but prices of material are said to be having some effect on the situation. Modern houses of four to six rooms are badly needed.

New Pumping Plant for the Maple Ridge Dyking District in B. C.

Old Pumps, in Service for 27 Years for Reclaiming 9,000 Acres of Rich Land, Replaced by Two 20,000 g.p.m. Electrically Driven Centrifugal Pumps—Unusual Type of Valve

By H. M. BURWELL, M.E.I.C.
Consulting Engineer, Vancouver, B.C.

The Maple Ridge Dyking District, supervised by a dyking inspector under a provision of the "Drainage, Dyking and Development Act," is the official designation of the meadow land subject to overflow within the boundaries of the municipality of Pitt Meadows, in the lower Fraser River valley in British Columbia. It has an approximate area of 9,000 acres and is distant about 18 miles from the city of Vancouver on the main line of the Canadian Pacific Railway.

The reclamation of this rich delta land was started about 30 years ago, when a dyke was built to enclose the entire meadow area, which prior to this was covered with from five to seven feet of water during the freshet period of the Fraser River. Two pumps also installed, each with a capacity of about 13,000 g.p.m., designed by a man named Menge, and in the year 1913 an additional "Gwynn" centrifugal pump, with a capacity stated to be 25,000 g.p.m. was placed near the old plant.

With the exception of a culvert under the C. P. R. connecting the dredge cut along the inside dyke toe, an additional set of sluicegates at the north-westerly corner, and some dredged ditches along a few of the roads, no further reclamation work of importance has been undertaken up to last year, and although the old dyke and original pumps have given fairly good service for about 27 years there has been no comprehensive system of drainage started whereby the land can be thoroughly drained and the surplus water conveyed directly to the sluicegates or pumps.

Last autumn one of the sloughs or natural drainage channels was dredged out by the government to give better drainage facilities, and it is proposed to carry on further drainage work, so that, no doubt, in the near future the inhabitants of this rich district will awaken to the fact that the productiveness of their land will be greatly enhanced, as soon as a proper system of drainage ditches throughout the district has been completed.

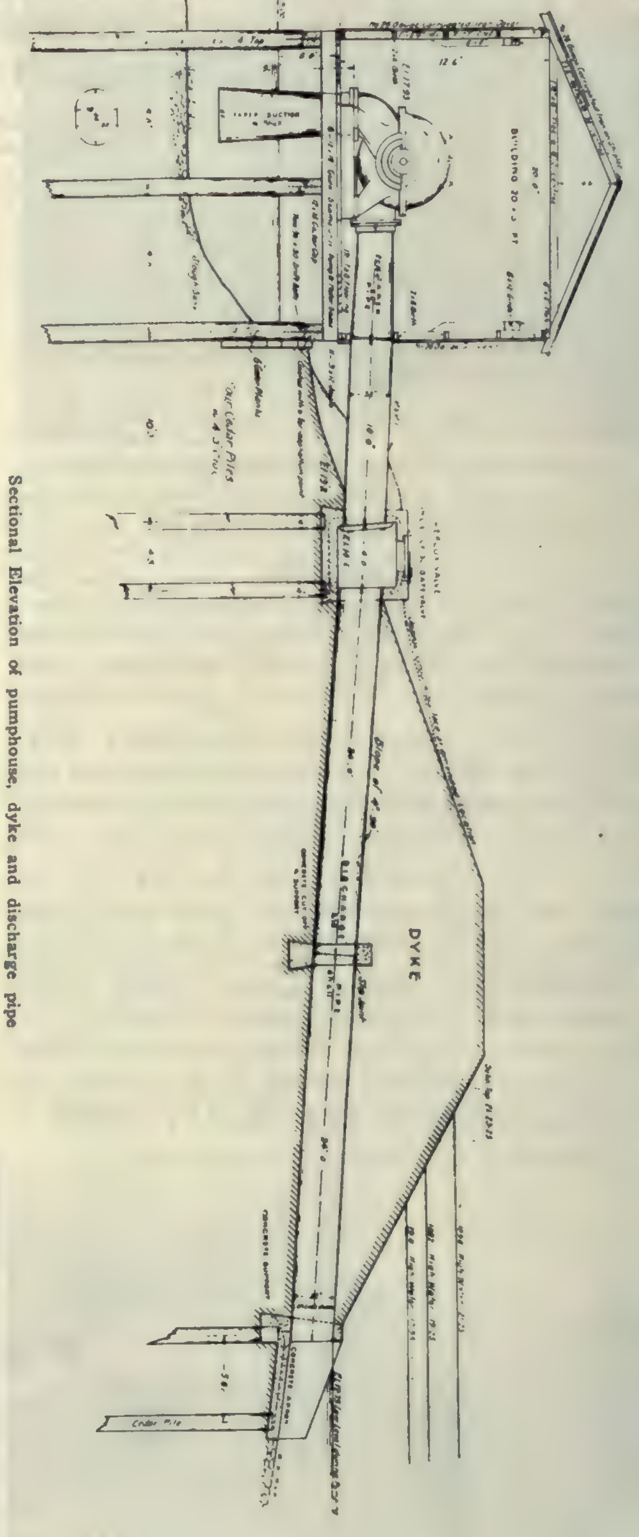
The Old Equipment

The Menge pumps referred to are constructed largely of wood and are really a type of centrifugal pump with a cast iron impeller and vertical shaft enclosed in a square wooden casing, with boxing, wooden guide planks and ports placed so as to allow the water to enter both from above and below the impeller. With this type of pump it would, of course, not be feasible to attach a suction pipe and consequently the impeller and the top port have to be placed below the lowest level to which it is desired to pump the water.

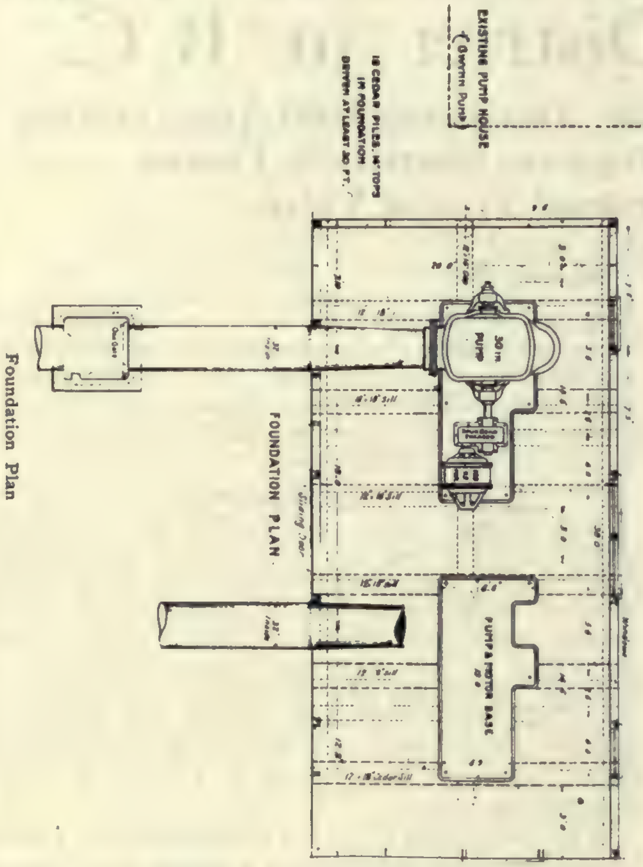
The installation of such a pump therefore generally involves deep and difficult excavations in ground which in this case was of a wet and silty nature down at the depth at which the foundation timbers had to be set. In placing such pumps the tendency would therefore be to keep above rather than below the desired level, and it has been alleged that had these pumps been set a few inches lower better service might have resulted. Such an error, however, as events have transpired, was of little importance, as no matter how well they might have performed their duty, proper drainage has been impossible for the reasons above stated.

After giving service for so many years the life of the original pumps ended with the completion of two

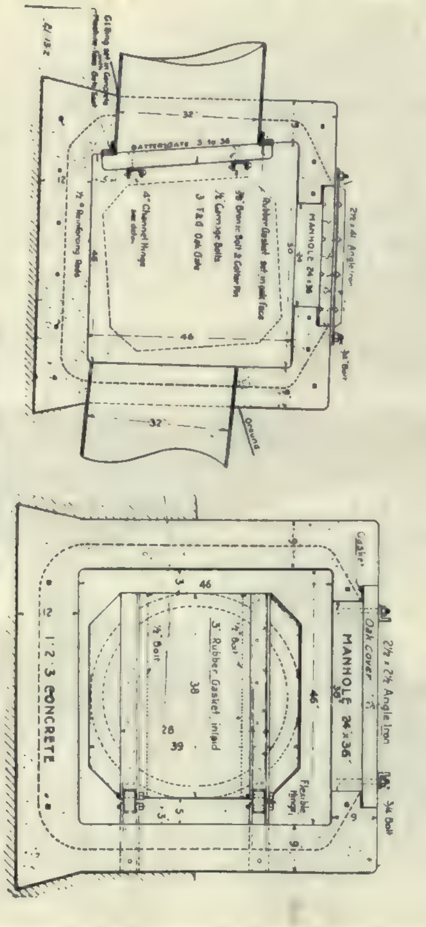
Exterior and interior views of pump house for the Maple Ridge dyking district in British Columbia



Sectional Elevation of pumphouse, dyke and discharge pipe



Foundation Plan



Reinforced concrete reflux valve

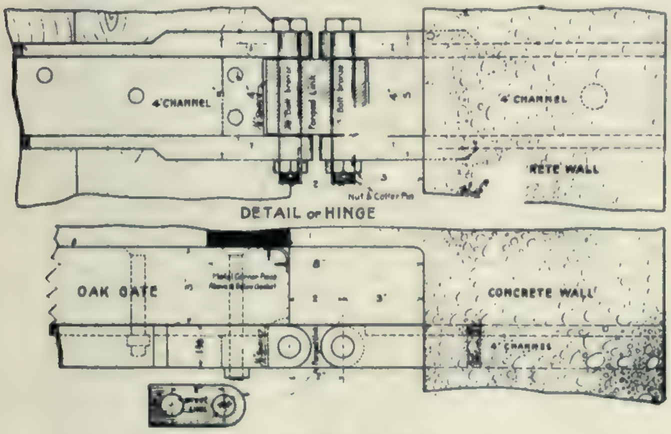
new units recently installed, a general description of which is as follows:

Two 20,000 Gal. REES-RoTURBo Pumps

Tenders were asked for "supplying (excepting the motors) and erecting two centrifugal pump units complete, each with a minimum capacity of 20,000 imp. g.p.m., against a head of 9 feet," also the bidder was requested to submit with his tender, performance curves and large scale drawings of the different parts of the equipment, and at a later date, if his tender was accepted, a general plan of the whole plant, together with working drawings of the foundations, proposed building, discharge conduits, suction pipes, valves, aprons etc. etc.

Robert Hamilton & Co. of Vancouver, B. C. were awarded the contract with a proposal to supply two 30 inch REES-RoTURBo pumps manufactured by Goldie & McCulloch Co. Limited of Galt, Canada. The guaranteed efficiency of these pumps is 73 per cent when discharging 23,000 imp. g.p.m. against 10 feet head, 71 per cent when discharging 25,200 g.p.m. against 9 feet head and 67 per cent when discharging 27,000 g.p.m. against 8 feet head. The speed is 230 r.p.m. and the b.h.p. ranges from 95 to a maximum of 98.

The accompanying general plan and details were prepared by the writer for the contractor, and show the pumps and motors set upon a timber foundation consisting of substantial cedar piles, caps and beams. This type of foundation was proposed on account of its much lower cost than that of concrete, which in this case would have been prohibitive. It is anticipated that the cedar will give good service for at least 30 years and probably for a longer period.



Details of Hinge

Unusual Type of Valve

An unusual feature of the discharge conduit, it will be noticed, is the reflux-valve which is really a flap-valve swung from the side, but instead of being placed, as is usual, at the outlet end of the discharge pipe, it is enclosed in a reinforced concrete chamber placed 18 feet from and at the same level as the pump. This position was adopted in order to give greater accessibility to the valve, and to facilitate priming.

The practice generally in this and the neighboring districts (where the adjoining waters are tidal) has been to swing sluicegates from the side rather than from the top, and after 30 years' experience, this practice has proven to be the most satisfactory, owing, no doubt, chiefly to the fact that gates so hung swing clear of the current and are not so likely to become clogged up with weeds or other floating debris.

It may be here mentioned that the adjoining tidal water has a rise and fall of about four or five feet during normal periods when the accumulated water within the dyke is discharged through the sluicegates which act automatically with the rise and fall of the tide. During the freshet period of the Fraser River the sluicegates cease to operate and the drainage of this land then depends upon the operation of pumps.

The reflux-valves adopted eliminate the use of the usual gate valve, and will act automatically without any attention from the operator in charge of the plant. They have oak gates faced with inlaid rubber gaskets and provided with flexible hinges to adjust themselves to the gate seats, which are tooled cast-iron flanges rivetted to the steel discharge pipes.

The whole is enclosed in reinforced concrete chambers provided with man-holes of sufficient size to easily inspect or remove a gate and make repairs if ever found necessary. The chambers were made to be as nearly air-tight as possible, and the concrete actually adopted consists of a rich mixture of one sack of portland cement to 1½ cubic feet of sand (1 fine to 2 coarse) and 2 cubic feet of torpedo gravel.

Pumps Electrically Driven

Each pump is driven by a 100 h.p. electric motor formerly used to operate a Menge pump. Its baseplate is extended to receive this motor and also a reduction gearing made of cut cast-steel pinions running in oil, with ring oiled bearings, all enclosed in a cast-iron casing. The priming is accomplished by means of a No. 4 rotary vacuum pump operated by a 2 h.p. electric motor connected through a speed reducing gear. The time required to prime a pump is usually about 8 minutes.

The contractor's price for supplying and installing the pumping equipment, as above specified, was $17,047.00, which price included discharge and suction pipes, also valves. The dyking inspector, Mr. Bruce Dixon, made all the necessary excavations and provided foundations, building, concrete aprons, etc., which it is estimated cost about $8,000.00, bringing the cost of the entire plant up to about $25,000.00.

The new plant was put into operation by the contractor for a final test, on Feb. 21, 1922, after which both pumps were delivered to the dyking inspector's representative, in perfect working order.

At first when trying to prime the pumps it was found that the wide rubber gaskets on the valve doors did not give a proper contact (due to inequalities). These were taken off and grooves were cut into the faces of the oak doors, into which were inserted "Tucks" packing, 1" square, held in place by ¼" x 1" metal rings on each side, allowing the packing to project ¼" beyond the face of these rings. A cast iron weight of 130 lbs. was also bolted to the back of each door to facilitate its closure. These improvements have placed the valves in first class working order, so that as soon as a pump is stopped the door closes gently and is ready for the next priming.

Aerial Terminal Supports

The tripod section of the supports should approximate one-half the total height and be made of rods not less than ¼ inch in diameter. The upper section of the tripod support, if of one piece, must be not less than ⅜ inch in diameter and if more than one piece must have equivalent strength and rigidity.

New Reservoir Overflow for the Victoria, B. C., Water Works

Necessitated by the Annual Flooding of the Reservoir by Surface Water—Consists of a Concrete Lined Canal Section and a Welded Steel Pipe Line in Connection With Which are Several Unique Features

By **J. B. HOLDCROFT, A.M.E.I.C.**

Among the works at present in hand by the city engineering department of Victoria, B. C., is the construction of an overflow to the "Humpback Reservoir," which lies at the end of the flow-line pipe from Sooke Lake, the source of supply, and operates as a balancing reservoir to the pressure main beyond. The construction of the overflow has been under consideration for some years, and is necessitated by the annual flooding of the reservoir by surface water from the catchment area of which it forms the lowest point as an artificial lake. To relieve this flooding and to prevent the impounded water from overflowing the earthen dams, it has been necessary to open washout and drain valves in the pressure main at times of high water, which practice has led to a great deal of litigation and awards of damages against the city, on account of the flooding of farm lands caused thereby.

Matters came to a head in 1921, and the city engineer, Mr. F. M. Preston, A.M.E.I.C., was instructed to prepare plans and to call for tenders for the construction of a satisfactory overflow. The plans as prepared called for a reinforced concrete lined canal section about 600 feet long, 6 feet in width at the top and approximately 3 feet in depth. This section at its junction with the reservoir is widened out to a fan-shaped junction section, with vertical walls, and will make a well-bonded connection with the concrete cut-off wall of the earth dam which exists at that point.

Hydrostatic Test for Pipe Line

At the end of the canal section, the construction changes and a pipe section is specified. The pipe is to be buried for practically the whole of its length and several alternative forms of construction were allowed to bidders. Reinforced concrete might be used, or steel with riveted joints, or steel with joints welded by either the electrical or the oxy-acetylene process. The contractor was to specify the type of field joint proposed to be used, and was to guarantee the work for a period of two years after installation. The test required consists of stopping up the lower end of the pipe and filling the entire line with water, and was framed to provide for the possibility of the lower end of the pipe being choked by accumulation of debris in the ravine, thus subjecting the pipe to the full hydrostatic head due to its fall of 270 feet.

Tenders were called for during December, 1921, and two bids were received, in addition to which the city engineer presented an estimate of the cost of doing the work by day-labor. The lower of the two tenders received was $21,300.00 for the whole work, and was based on the installation of steel pipe electrically welded, with flanged and bolted field joints. The city engineer's estimate, however, was about $3,000. lower than this, and the council decided to proceed with the work on the day labor basis, letting a contract, however, to the Victoria Machinery Depot for the supply and installation of the steel pipe, with both shop and field joints welded. As this pipe is of relatively large diameter and is to be subjected to hydrostatic test as described, the job will be of interest as showing the possibilities of a method which is still comparatively new as applied to pressure work.

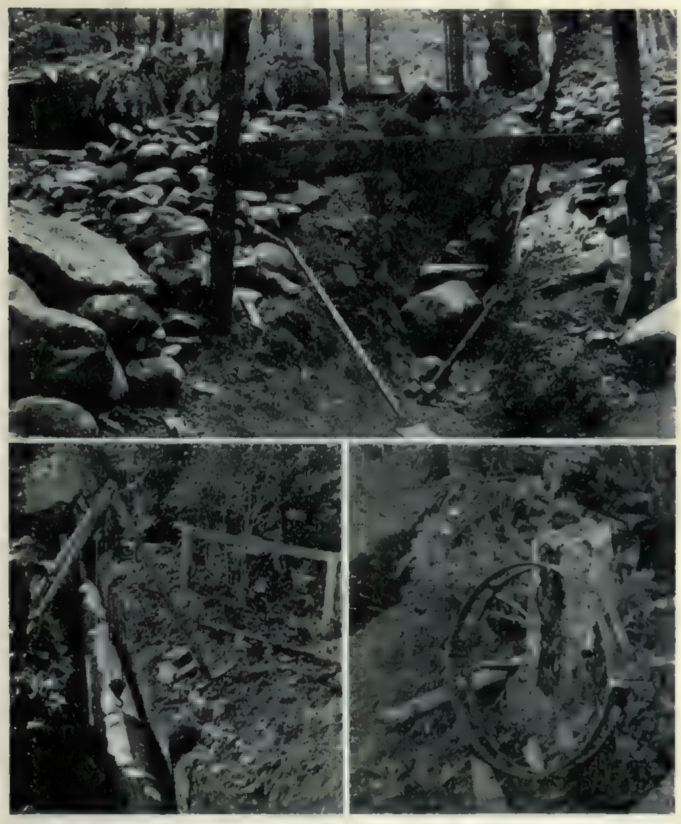
The steel pipe section of this overflow is of considerable interest, as it will form when completed certainly the longest homogeneous section of steel pipe on the Island. This is due to the fact that there are no calked or bolted joints, all connections being made by welding. The total length of steel is 1,960

General view of Humpback Reservoir near Victoria, B.C.
Water lowered for construction of overflow

Intake end of new overflow, Humpback Reservoir feet, and two sizes are used, 27" for most of the distance, followed by a section about 500 feet in length of 20" pipe to the outfall. This is on account of the greatly increased steepness of the grade on this section, being the side of the canyon of Goldstream, with a drop of about 120 feet in the 500 feet of length.

The specification for the pipe provided that all seams and joints, if welded, should have a strength of at least 90% the strength of the section of steel used, and provided also for a test of the whole length after installation, the test to be performed by stopping the lower end of the pipe and allowing the full static head to be developed by filling the pipe with water from the reservoir.

A feature of the design is that the entire length of pipe is to be buried to a depth of about three feet to the top of the pipe. This is a necessity as no expansion joints are provided, and it is expected that at the depth indicated the expansion and contraction will be negligible. The method of construction adopted has been to fabricate the pipe in the shop in lengths of about 20 feet. These lengths were shipped out from town to the job, a distance of eleven miles by railroad, were then handled at the trench in the ordinary way with tripod and tackle.



Upper:—This view shows the character of the excavation near the bottom of the Goldstream canyon. Lower left:—Steel pipe in trench ready for jointing. Lower right:—Strap used for jointing pipes. Slots cut out as shown enable welding of short sections so that joint is solid when strap is removed to complete weld.

Welding of the Joints

All welding, both shop and field, has been done by the oxy-acetylene process. The specifications provide that there should not be more than one longitudinal seam in any section of pipe, and that these seams should be staggered from section to section. For making the field welds, a strap of special pattern was used, consisting of two half straps with tightening bolts, each part having a series of slots which expose the ends of the pipes being joined. The lower half of each field joint was welded from the inside of the shell, and the upper half from the outside, this being necessitated by the fact that the pipe once in place could not, of course, be turned about. The slotted straps described made it possible to weld the joint in spots through the slots, thus making all fast before the strap was taken off for final welding all round.

At the test of the first section of pipe laid, which is about 1,000 feet in length, it was found that the method of jointing used is entirely satisfactory. Under the full static head, which at that point is about 150 feet, no leaks of any consequence were found, and such seepages as were developed proved to be in the shop joints rather than in the field work. It turned out that some little difficulty has been experienced with the torch on one occasion, which resulted in a few cool spots imperfectly fluxed.

The illustrations accompanying give a good idea of this portion of the work, and of the strap used for jointing. The lower portion of the trench excavation is waterworn gravel, and at the bottom of the canyon of Goldstream consists largely of boulders of "man-size" and larger. This has made the excavation costs heavier than was at first anticipated as the location is such that hand methods must be used exclusively.

No unusual difficulties were encountered in the construction of the concrete canal section, apart from the ordinary difficulties attendant on this class of work when carried out in heavily timbered and withal swampy country. It was necessary to build a road in to the site and alongside the canal section for the transport of materials, etc., which of course added to the cost, and as relief labor had to be employed in large measure, an unverified report is current that the estimated cost has been to a certain extent exceeded. No positive information is available on this point, however.

Poor Puddling Material

The opening of the dam at the reservoir for the purpose of breaching the core wall and constructing the intake provided an interesting sidelight on the methods of earthen dam construction. As already stated the corewall of this dam is of concrete construction 12 inches in thickness and extending down to bed-rock, a distance of 6 feet more or less. Previous to the commencement of the work on the overflow, a slight seepage was noticeable from this dam, but nothing to cause any uneasiness. It was found on opening up the section, that the corewall trench was in a semi-liquid condition—saturated to such an extent that a man standing on the material would very quickly sink to the hips. The dam itself and the untouched ground under the fill were firm and in good condition, but the condition found in the trench while possibly due to an injudicious selection of puddling material when the dam was built, points to the possibility of failures through fracture of the corewall where such conditions are aggravated, especially if duplicated on the downstream side.

The illustrations herewith show a general view of the reservoir with the water level considerably lowered for construction purposes, and a view of the intake end of the canal showing the breach in the corewall and reinforcement in place for the new sidewalls. The canal itself is to the left of the picture, and is shown completed, with a three inch board covering over the entire length.

The Water Supply of York Township Adjoining the City of Toronto

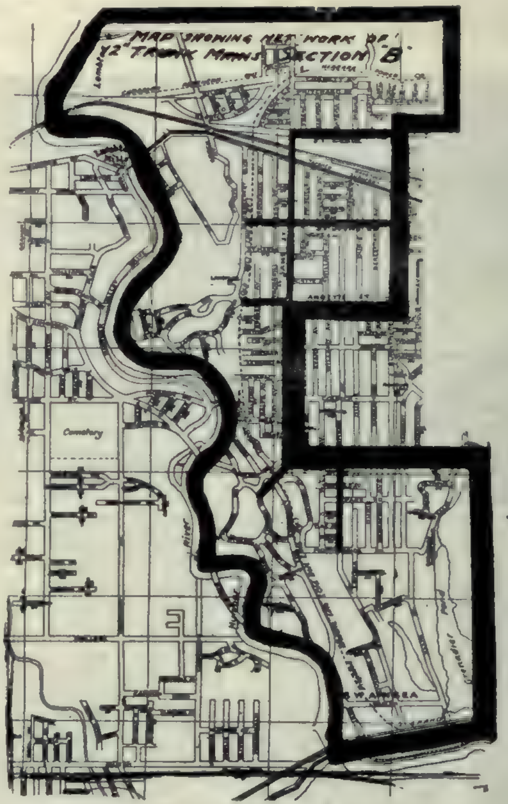
How 55,000 People Living Just Outside the Limits of the City Derive Their Water Supply—Township Divided into Three Sections—City Standards Adopted

By R. O. WYNNE-ROBERTS
Water and Sewer Engineer, York Township, Ont.

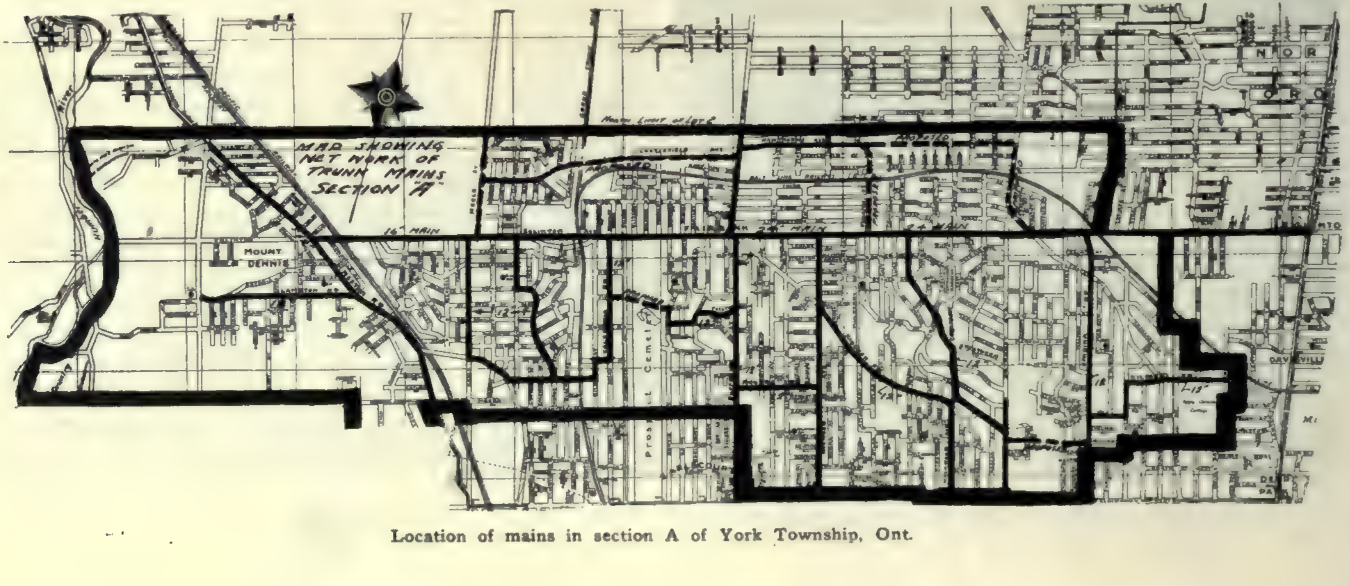
York Township is the municipality adjoining the city of Toronto on the north and west sides and has a frontier between it and the city of about 18 to 20 miles. The population in the urban portions of the township numbers in the vicinity of 55,000. The residents north of St. Clair Ave.,—which is virtually the northern limit of the city of Toronto—for a considerable time had been agitating for a proper supply of water, inasmuch as many of the wells, on which they were depending, were either inadequate, uncertain or polluted and the township council took the matter in hand, negotiating with the city. It applied for statutory powers to construct water works in the urbanized area of the township and finally a private bill was passed. This bill empowers the township council to divide the area into definite water sections which are now known as sections A, B, and C.

Section A represents the portion lying north of the city and west of Avenue Road as far as the Humber River. Section B lies west of the city and south of the Niagara Power Transmission Line. Section C is the portion occupied by Todmorden, Greenwood and Danforth Park, that is between Scarboro township and the Don River.

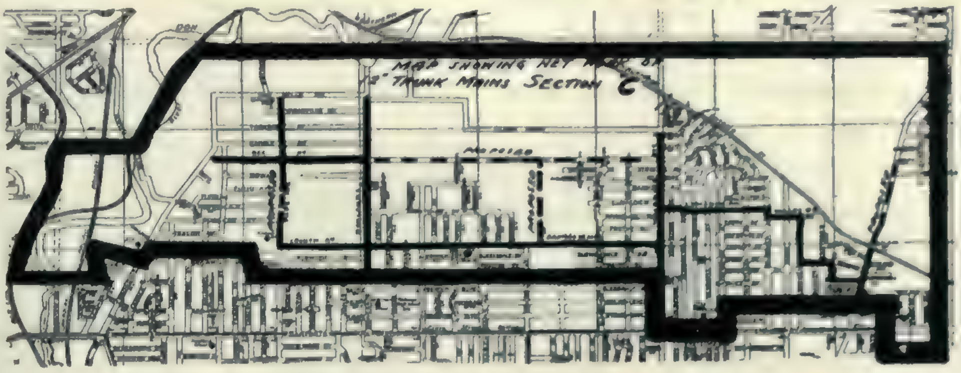
The first portion of the township to have watermains laid was section A and a 24" main was laid along Eglinton Avenue from Duplex Avenue to Keele Street, a distance of about 3.89 miles and from that point a 16" main as far as Weston Road, a distance of ¾ mile. From this trunk line 12" pipes were laid down Spadina Road, Strathearn Avenue, Oakwood Avenue, Vaughan Road, Rogers Road, Dufferin Street, Caledonia Avenue and Keele Street and between these again 6" pipes have been laid. An emergency 12" connection has been installed at Oriole Parkway with a compound meter on the same. The water supply for section A is from the city high level system at Duplex Avenue and is measured by means of a venturi meter and at the western end the pressure is reduced by a Glenfield & Kennedy pressure regulating valve.



Map of Section B.



Location of mains in section A of York Township, Ont.



Section C. of York Township, Ont.

Section B obtains water from St. Clair Avenue, Annette Street and Bloor Street. The meters on St. Clair and Bloor are Helix meters; on Annette Street there is a venturi meter.

The water supply for section C is obtained from Danforth Avenue by means of a temporary connection on Monarch Park Avenue. Inasmuch as it was uncertain as to whether the city would be able to give a constant supply at a uniform pressure it was part of the arrangement with the city that the township should erect a 200,000 gal. elevated steel tank, the bottom of which is 100 feet above the ground and the top water level is at 153 feet. The water supply to the tank is controlled by a Golden-Anderson altitude valve. Adjoining it is a pumping station which contains electric driven and controlled pumps to boost the city pressure into the tank and if found necessary in the future will have electrically operated and controlled fire pumps. The meter on the Monarch Park connection is a 6 inch compound.

Domestic meters are installed on the consumers' premises wherever it is found that adequate provision against frost can be made. The exceptions are relatively few.

Hydrants of the Toronto city pattern are located every 300 feet and generally the whole design, class of materials, fittings, etc are of city pattern so that when any section of the township is annexed, at some future date, the whole of the works then transferred will conform to the city standard. As a general rule all mains, of which there are about 97 miles (Dec. 31, 1921), are laid about 17 feet from the north and west sides of the streets and the valves at intersections are placed in line with the street line and other valves are set about 600 feet apart. The city charges the township 20 cents per 1,000 gallons for the water and the township charges the consumer 30 cents to cover incidental charges and losses. At the present time the average consumption per consumer daily averages 22 gals.

The yearly expenditure for equipment is shown in the table below:

Waterproofing of Stone, Brick, Concrete and Stucco

Why stone, brick, concrete and stucco require waterproofing and the properties a permanent waterproofing should possess, are discussed in a Technical Pamphlet which has just been published by the Obelisk Waterproofing Company, 197 Sparks St., Ottawa, Ont. There being no over-abundance of information on the subject of waterproofing, an endeavour is made in its pages to fill the need of a treatise on the fundamentals of this most important subject. This publication is more along the lines of a practical and technical handbook than is usual in this class of trade literature. The booklet is short and concise, and can be mastered in less than an hour; will be mailed to any architect, engineer or builder on request.

The Department of Labor, Ottawa, has issued as supplements to the Labor Gazette of February, 1922, a report entitled "Wages and Hours of Labor in Canada, September, 1920, to September, 1921", and a bulletin entitled "Canada and the International Labor Conference".

Watermains—Sections "A" and "B"

	6-inch miles	12-inch miles	16-inch	24-inch miles	Total cost
1917–8	1.96	5.91		2.60	$331,352.63
1918	11.67	2.47			238,701.99
1919	16.78	1.46		0.26	253,746.65
1920	13.73	2.24	.74	1.03	458,054.00
1921	16.87	.67			336,182.00
	61.01	12.75	.74	3.89	$1,618,037.27

Section "C"

		miles			
					444,290.00
1921	13.04	5.50			60,000.00
Tank and Pump House and land					

Canada Crushed Stone Plant Speedily Reconstructed

No Time Lost in Handling Business, Disrupted by Bad Fire Which Destroyed Part of Dundas, Ont., Quarry Plant

On April 29th last a bad fire occurred at the plant of the Canada Crushed Stone Corporation, at Dundas, Ont., destroying their large screen house, their conveyor system and the 72-in. roll house. The fire is thought to have been started by sparks from an acetylene torch falling down in the partition of the bins in the screen house, where it is possible that some sawdust or shavings may have accumulated. The screen house is the timber-enclosed structure in the centre of the plant, in photograph No. 1 herewith, which had been undergoing reconstruction. A strong south-west wind, blowing toward the mountain, caused the fire to gain headway at a tremendous speed, rapidly destroying the screen house, the large section of the conveyor system between the screen house and the 72-in. roll house, also shown at the top of the mountain in photograph No. 1, and the timber work of the latter building. There were fire hose and extinguishers on the trestles, but the rapidity of the fire made it absolutely impossible for the men to bring these into use, they finding it necessary to avail themselves of every moment to get safely away from the burning structures. Fortunately, however, there was no loss of life, a few of the employees suffering but minor injuries from slight burns. The transformer house, which is to the right of the plant, near the top of the mountain, and slightly out of the path of the flames, escaped damage entirely, as did the big crusher at the top of the mountain.

Extent of Damage

Photograph No. 1 shows view of the plant taken in February, 1921, with ground storage stock piles in the foreground. In the centre of the plant is the screen house or bin building, in which the fire started. The building at the top of the mountain is the 72-in. roll house and immediately below this is the trestle work over which the cars of rock are brought in from the quarries to the crusher.

Photograph 3 was taken after the fire, from about the same angle as photograph No. 1, and shows the wreck of the screen house and roll building. Nothing remains of the conveyor system at all.

The plant had been closed down for a month previous to the fire, in order to make extensive repairs and alterations to the screen house and to install four new shaker screens in preparation for a busy season in the crushed stone industry. This new equipment was destroyed; in fact, the only machinery salvaged was in the roll house.

Illustration No. 2 shows a closer-up view of the screen house. On top of the steel work will be noticed what is left of the four 48-in. x 30 ft. screens. The four new shaker screens can hardly be detected. The huge locomotive crane seen in the picture is hard at work rapidly cleaning up the wreckage. In the background can be seen the large stock piles of stone on hand, estimated at between 40,000 and 50,000 tons, ready for shipment to supply the immediate needs of the company's customers. It will also be seen in this picture that the construction of the conveyor system has changed from that shown in picture No. 1, the straight towers shown in the first illustration having been replaced with "A" frames, which span the stock piles. It was found that in drawing stone through tower No. 1 that the bracing was being torn away by the pressure and movement of the stone as it was taken out, so that the "A" frame was substituted, completely spanning and allowing the expansion of the huge stock piles. This extension amounted to 140 ft. during the past year. The tower at the extreme end of the conveyor system will be boxed in, the same as in the first illustration, and used to handle screenings.

Speedy Reconstruction

The actual loss to building and machinery is estimated at $200,000.00 and the loss in business between $75,000.00 and $100,000.00, all well insured. No expense is being spared to obtain the utmost in speedy, sound reconstruction.

While the fire was still burning, the officials of the company got in touch with their consulting engineer, Mr. J. C. Buckbee, of Chicago, and arranged to have him visit the plant at once to consult with them on plans for the reconstruction. Arrangements were also made that day to have a locomotive crane installed at once to get to work on the job of cleaning away the wreckage. The men employed at the plant, together with the wrecking crew accompanying the crane made up a large staff who went to work the following Monday morning on the clearing of the ground.

A working plan of the proposed new plant was prepared by the engineer and agreed upon at a meeting of the officials on Tuesday and the steel contractors were immediately instructed to commence work on the new buildings. The concrete contractors were on the job on Monday, May 8, and commenced the erection of the form work. It is thought possible that the reconstructed plant will be in operation by June 19 and in the meantime the company has the large stock previously referred to, to supply the immediate wants of their customers.

The Very Latest Improvements

Plans for the new plant, as prepared by Mr. Buckbee, will give this company a plant that will be the last word in stone crushing machinery and equipment, will increase the output, and will tend to improve the size of the stone, more particularly as regards the ½-in. and ¼-in. sizes. Four new 60-in. revolving screens will replace the four 48-in. revolving screens and four 7 x 12. double-decked shaking screens will be included in the new equipment. These latter screens are something new in crushed stone screening equipment. New conveying machinery and conveying feeders are being purchased and all new structures will be of concrete and steel construction to give stable and fireproof structures, with the added advantage of speed in erection.

Everything possible is being done by the company to get back on a production basis at the earliest possible moment, and even at the date of this writing, May 8, much has been done in the way of making a start on the new program, clearing the site for the new plant, which, when completed, will be modern in every respect and capable of rapid handling and accurate grading of a huge daily output of crushed stone for the local market.

The damage to the transportation facilities was slight and required the replacing of a short section of track.

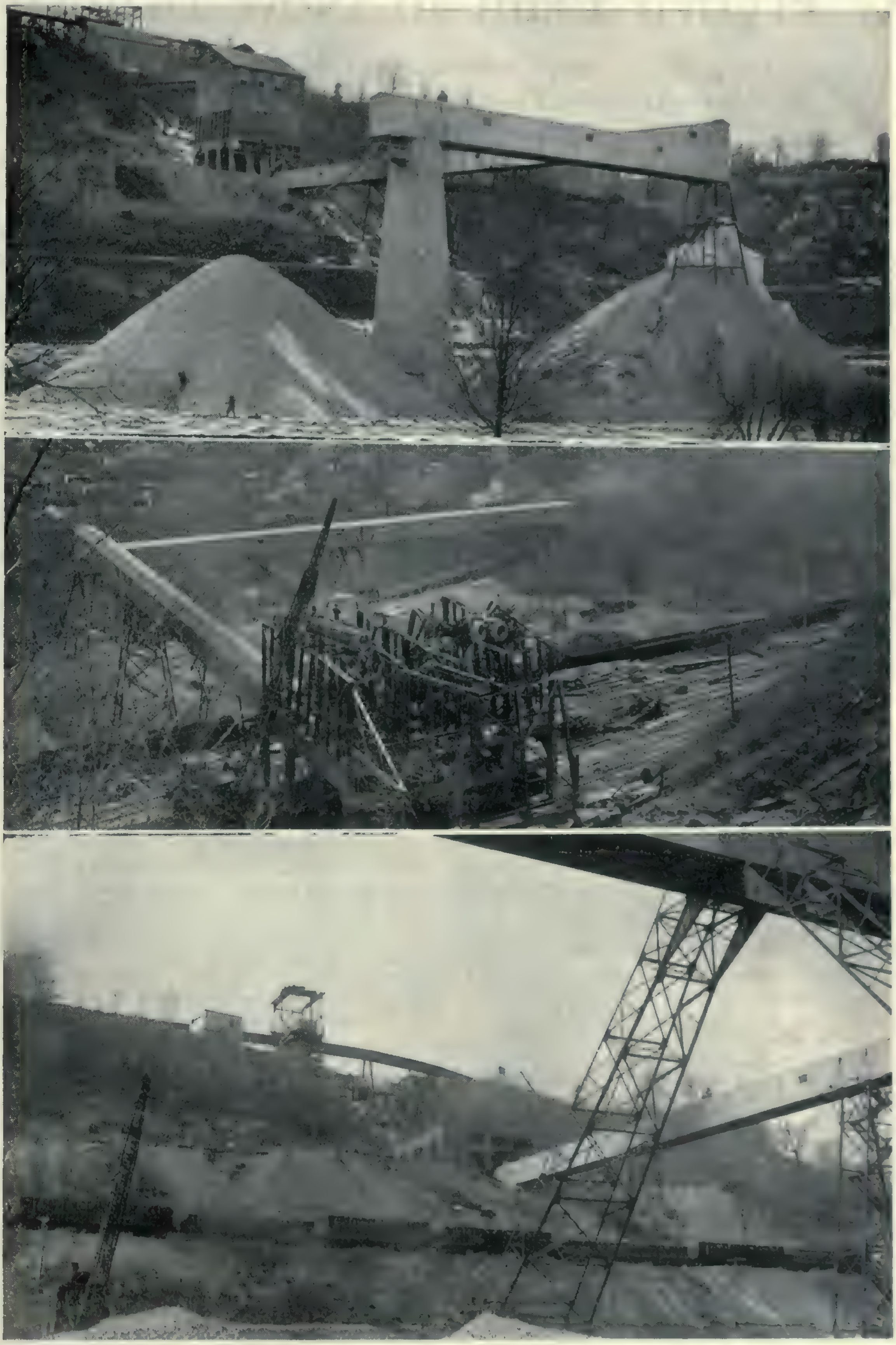


Fig. 1—View of Canada Crushed Stone Corporation's plant at Dundas before the fire of April 29th. Fig. 2—Large crane cleaning up the wreckage of the screen house. Fig. 3—A general view of the plant after the fire.

New Hydro Plant in New Brunswick

Unique Installation Just Completed at Musquash River, Near St. John—Actually Two Plants in One—The Work of the New Brunswick Power Commission

The New Brunswick Electric Power Commission have issued an interesting report on the Musquash hydro-electric development, which has just been completed, describing and illustrating various phases of the construction and design of this plant. The Musquash River has three branches, known as the West, the East and the North-east, the East being centrally located between the other two. The station is located on the channel of the East branch, but only the West and the North-east branches have been developed. The plant is quite unique in design, therefore, in that two pipe lines, fed from rivers more than two miles apart, converge at a common point, combining to operate generators in the same power house.

The general plan is shown in the accompanying illustration. The working head at full load on the West branch is 117 feet, and on the North-east branch 95 feet, after allowing for pipe line losses and tidal effects. Assuming 80 per cent. efficiency of generation, the first will develop 1,450 continuous horsepower and the second 1,550 continuous horsepower. The pipe line from the West branch to the power house is 8 feet inside diameter, 7,400 ft. long. That from the East branch is 10 feet inside diameter and 2,955 feet long. The latter will operate two turbines and the former one turbine, so that in the one power house there will be practically speaking, two developments, providing a two-fold reliability and insurance against interruption.

East Branch Intake Dam

This dam including the intake, is 1,500 feet long, and has a maximum height of 78 feet in the channel. From the western end, 874 feet of concrete gravity section, including spillway, is built upon granite ledge foundation well across the stream to the high bank on the East side. From this point an earth dam with concrete core wall extends to the intake. This intake and core wall at both ends are on solid rock, and the central part of the core on good clay hardpan. East of the intake a concrete core has been carried one hundred feet into the natural bank and earth embankment graded. There are 14,657 cubic yards of concrete in this structure and 15,350 cubic yards of embankment. The dam is provided with a stop log sluiceway eight feet wide to a depth below the level of the intake. This will permit of lowering the water to that depth, of running trash from the pond, and in the future if any lumber should become available on the waters of the stream, a log sluice can be built through the dam. There will be a pondage of 1,500 acres above this structure. The plant can be operated 24 hours continuously at average capacity, and this pond would be lowered less than three inches. It is not intended to depend on this pondage, however, for storage, except for daily regulations. Any considerable lowering of this water level would reduce the head and consequently the power. Provisions have been made on the spillway of the dam so that two feet of flash boards can be placed during the decline of a flood. The water so imponded would be drawn to further conserve storage.

To impound the water at the level of this dam eight earthern dams had to be constructed in various depressions near the lower end of the pondage. These as well as the main structure, have been completed.

West Branch Intake Dam

The main dam is located upon the site of the old driving dam, known locally as Scott Falls. A concrete section 224 feet long is built across the stream bed. It is 55 feet high at the deepest point in the channel. On the East side an earth wing 1050 feet long has been constructed with a concrete core wall, and on the west side a similar construction 700 feet long, making the total length 1974 feet. There are 8432 cubic yards of concrete and 38,962 cubic yards of earth embankment in this structure. The water has already reached a level within four feet of the overflow and the structure appears to be 100% efficient thus far.

Three side dams were required in this case also. These were built of earth, rip-rapped on the water side , as are all the earth dams, and contain 21,463 cubic yards of embankment. The area of the pond will be 500 acres.

A canal 900 feet long extends from a point above the eastern end of the main dam to the concrete intake house located between two solid rock banks.

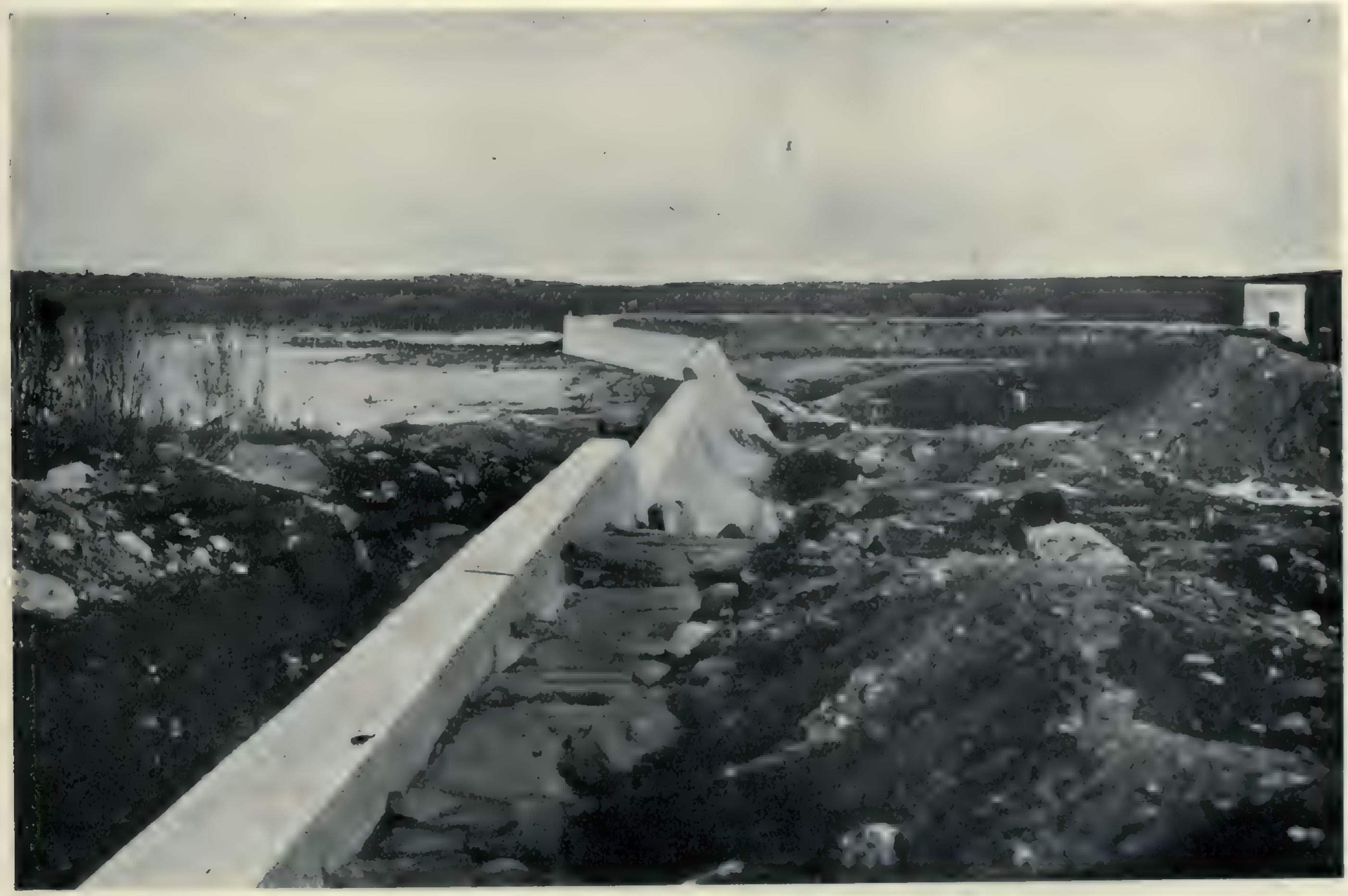
Storage Dams on the East Branch

Dams at the foot of Loch Alva will raise the water 19 feet above summer level. The main dam is a timber structure, built on solid rock, and provided with spillway and two gates for regulating the flow. There will be 1,250,000,000 cubic feet of water impounded, enough to operate the plant at full capacity 83 days. Three side dams were necessary to close gullies near the lower end of the lake. In all four dams there are included 34,537 cubic yards of earth embankment, 3,723 cubic yards of rip-rap and 173,000 feet board measure of timber. The country adjacent having been fire swept several years ago, no timber was available at the site, and had to be hauled over four miles from the railway. The level of this lake has now been raised about ten feet and the dams are giving entire satisfaction.

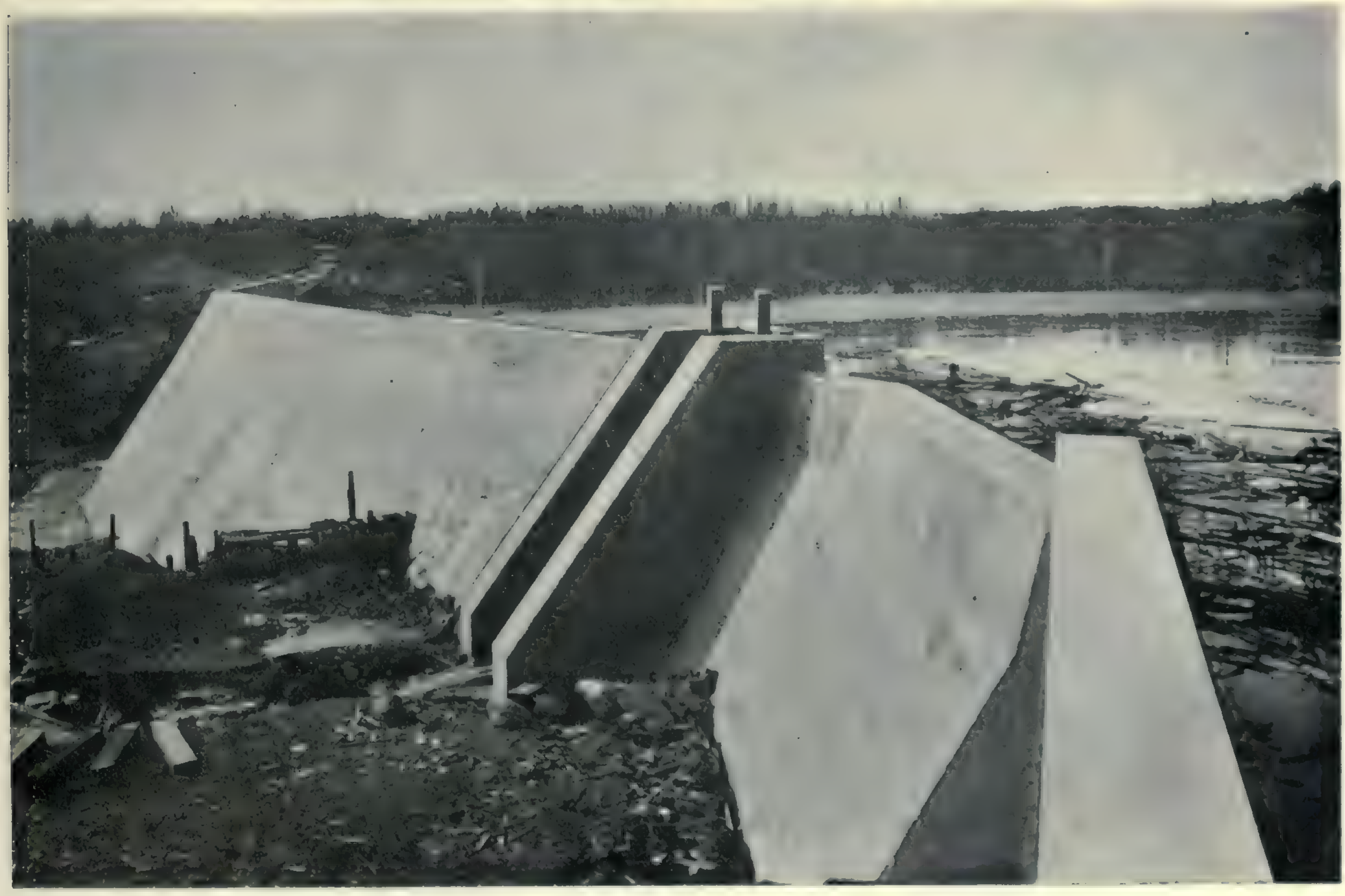
Other storage sites on this stream which will be developed as required include: Eagle Lake, Deer Lake and Belvidere Lake.

Storage Dams on the East Branch

At Log Falls, just at the upper end of the flowage from the intake dam, a yellow birch timber dam has been constructed, thirty feet high and about 400 feet long. The timber was cut from Crown Land nearby and sawn at the site last spring. Two small earth side dams were also built. Owing to the nature of the gravel bank on the west side some trouble has been experienced in getting a saisfactory connection between the structure and the natural bank, and a



Musquash Development—General view of east branch intake dam and gate house



Musquash Development—East branch intake dam

Musquash Development—West Branch intake dam; concreted overflow section

Musquash Development—Up stream view of Log Falls storage dam, under construction crew is now working to extend the structure further into this material.

There will be 900,000,000 cubic feet of water impounded in this flowage.

In these structures 6,121 cubic yards of earth embankment and 335,000 feet of timber are used.

It is the intention to construct during the coming summer a dam at the foot of Sherwood Lake, further up the West Branch, to store 650,000,000 cubic feet of water. There is in addition 300,000,000 cubic feet of storage that can be controlled at a low cost on Seven Mile Lake.

All the work on the dams now completed has been done by the New Brunswick Contracting and Building Co., Ltd., the intake dams under their first contract and the storage dams under a contract signed in February, 1921, after calling for tenders in the case of the Loch Alva Dams.

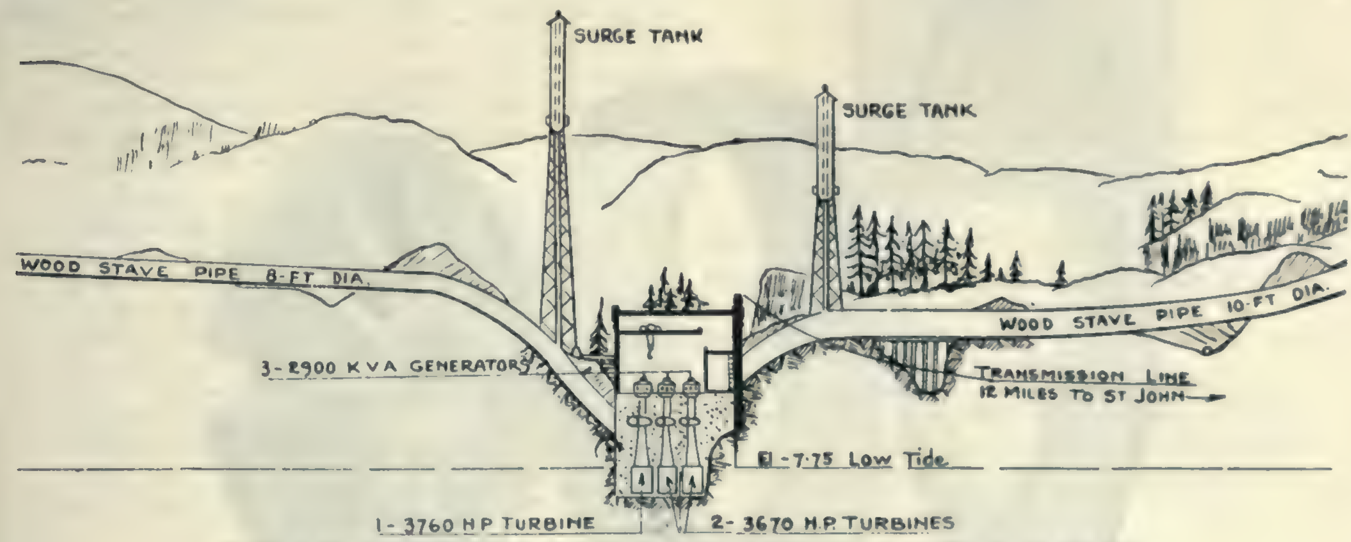
The Log Falls dam was awarded without tender, as the price of sixty dollars per M. feet for timber erected in place, including stumpage rate and fastenings, was considered as low as could be expected. Furthermore it was essential that this work be undertaken promptly so that the timber could be hauled on the ice. As it turned out the last timber was hauled only a couple of days before the ice on the flowage became unsafe.

to withdraw sections of the trash racks for cleaning or repair, and sufficient floor surface has been provided on the operating floor to allow of all stop logs being housed, when not in use, inside the building, so that minimum labor is required in handling. The windows are of steel sash, each window being provided with a ventilator.

Pipe Lines

The pipe lines from the intakes to the surge tanks near the generating station are constructed of B. C. fir wood stave, held by steel bands spaced at short intervals of a few inches. The staves are milled radially, so that when drawn up by the steel bands, the faces of the longitudinal joints press together, forming a perfect water tight joint. To prevent leakage at the butt joints the staves are notched and fitted with steel tongues. This allows for slight expansion and contraction of the wood. The pipes are carried on wooden saddles laid on an even grade a considerable length of the latter, in the case of the West Branch pipe line, being of close corduroy where the sub-soil is marshy.

The generating units are of the vertical type, the turbines and auxiliary equipment being supplied by S. Morgan Smith Company of York, Pa., the governors by Messrs. Lombard of Ashland, Mass., and the generators by the Canadian General Electrical Company of Peterborough, Ontario. Each generator is of 2,900 kv.a. capacity at 13,200 volts, and carries above it and directly connected to it on the same shaft, an exciter capable of supplying direct current sufficient to excite two generators. The provision of exciters of this capacity not only ensures continuity of service in the event of failure of one exciter, but also materially simplifies the regulation of the voltage of the generators.



Profile of Musquash hydro electric plant showing how one power house is supplied by two pipe lines

Intakes

At both the East and West head ponds solid rock was uncovered at the sites of the intake houses, particularly good conditions being found at the West Branch site where the intake house has been placed in a rock cut, only short wing walls at either side being necessary. Each intake is equipped with an intake gate, operated by geared hoisting equipment at the entrance to the wood stave pipe line, trash racks of large area to prevent debris entering the pipe; and emergency stop at the mouth of the intake. These stop logs can be lowered into position or raised in their guides by a pair of travelling chain hoists suspended from runways attached to the roof I beams. The intake house may be dewatered, and repairs to the intake gate or filler gates effected. In the body of each intake gate are small filler gates, by which the pipe line may be filled before the intake gate itself is raised. The stop log chain hoists may also be used

Fairville Switching Station

The switching station at Fairville is built of granite-faced concrete blocks. A steel superstructure is mounted on the roof of this switching station to accommodate emergency air break switches, for the purpose of sectionalizing the transmission line in the event of trouble occurring, should the line at any future time be extended beyond St. John towards the east.

New Type Manhole Cover

A Lighter and Stronger Design That Reduces the Cost of Replacements and Road Maintenance

Canada's municipalities will be interested in a new type of manhole cover which, judging by the experiences of several large cities, notably Chicago, has so many advantages as to recommend its widespread adoption in preference to existing types of covers. In design, the new cover is much lighter and stronger than the usual equipment and is more readily replaced without the damage to pavement that accompanies any replacements to present types of manhole cover. The cost of maintenance is thus extremely reasonable and many municipalities have developed a large saving by removing all old covers and installing this new type.

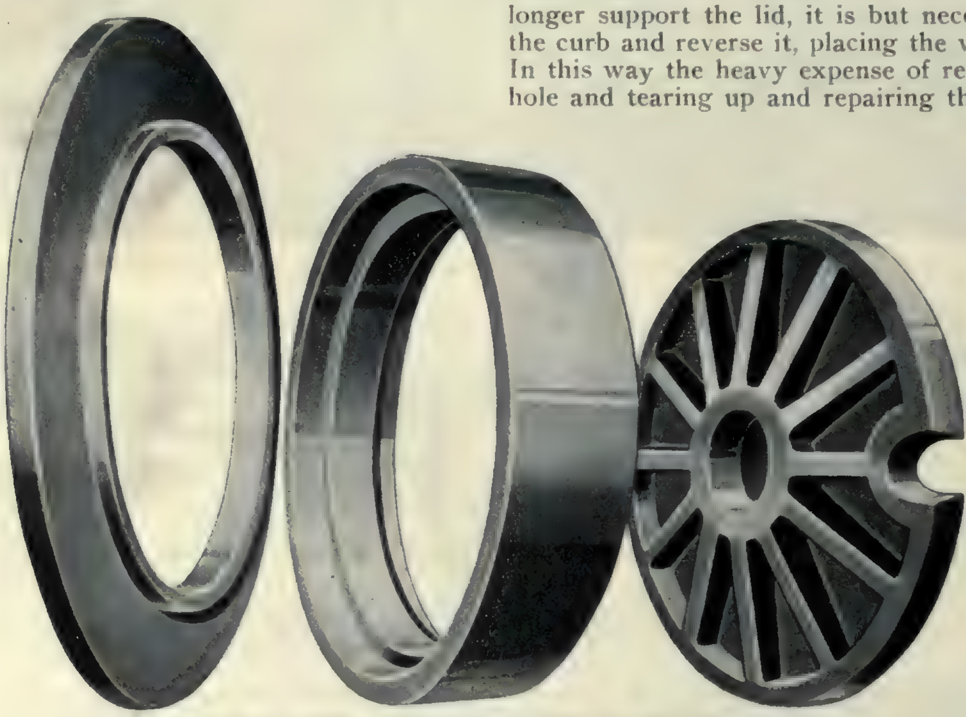
As this improved cover was developed in Chicago by the Bureau of Sewers and has consequently been given a thorough trial in that city, this article will outline their experience with a view to showing Canadian municipalities what may be expected of the improved equipment. The type of manhole cover herein described is now standard in Chicago and has replaced the old type on account of its many superior features. The old type manhole cover consisted of two parts, the base and the lid, the base being cast in one piece and embedded in the road surface, which made it necessary to tear up the street for several feet around in order to replace in case of breakage. This operation was costly and it was seen that a new type of manhole cover would have to be devised to eliminate this heavy expenditure. In addition to the item of cost, there were objections to the heavy weight of the cover and the rapidity with which the inner flange supporting the lid wore out, necessitating a replacement.

Mr. Francis Shanley, foreman of one of Chicago's sewer gangs, is responsible for the plans of the new manhole cover now used universally in that city, which overcomes all the bad points of the old cover and has solved the expensive problem of manhole cover replacement for his city.

The new manhole cover is made in three parts, instead of two as in the old type, and is eighty pounds lighter. It consists of a base, an inner curb and a lid. The base of the new manhole cover is permanent and needs no attention after it is once embedded in the foundation of the pavement. The base is 30½ in. in diameter and the outer rim is 1 in. thick, with the inner upright flange ¾ in. high and ¾ in. wide. This is laid on a cushion of sand when installed, so as to afford resiliency and to avoid breakage due to the weight of heavy traffic over the cover.

Resting on this base is the inner curb, which is 25½ in. in diameter and 6 in. high. The shell or outer rim is 1¼ in. thick and the inner flange 2½ in. thick. The flange extends inward from the shell 1½ in. thus affording a resting place for the lid. It is at this point that the desirability and practicability of the manhole cover is noted.

When the flange in the inside bearing becomes worn, due to the traffic over the lid, and will no longer support the lid, it is but necessary to remove the curb and reverse it, placing the worn side on top. In this way the heavy expense of replacing the manhole and tearing up and repairing the street is eliminated, as it is not necessary to remove the base to make the change.



A new type of manhole cover described herein is a three piece device

As all parts of the new cover are standardized, it is but necessary to replace the curb, when it is worn out on both sides, with a new curb, the old base and lid remaining in service, which operation can be carried out in six minutes. If the lid of a manhole located in a busy section of the city should be broken, another from a nearby alley may be substituted to take the place of the broken one. This means a big saving in time and the cost of upkeep is small..

It has been estimated that this cover has saved the city of Chicago millions of dollars in the replacement of worn out and broken manhole covers. The initial installation of either the old or the new type cover would be the same, namely $59.50. In replacing, the cost of the old type would be the same, $59.50,

No. 38

Canada's Contractors—O.N. Drouin

Oliver Napoleon Drouin, president of the Deschambault Quarry Corporation, Quebec City, is a man of many parts. Not only can he claim the distinction of having been thrice mayor of the ancient capital, but in every business sphere into which he has directed his personal activities he has been honored by election to the highest offices in the gift of his associates.

Thus we find that out of the interest he manifested in the good roads movement he became president of the Provincial Roads Commission, upon the work of which body, under his able direction, we need pass no encomium. The keen insight which made him so successful an administrator of the city's affairs made him an acquisition to the provincial government in the particularly touchy problem of dealing with liquor licenses throughout the province, and he was one of the five special commissioners appointed to conduct the work. Mr. Drouin is president of the Rock City Tobacco Company, and a director of the D'Auteuil Lumber Company, Limited, and La Banque Nationale. And these are only a few of his affiliations in the public and business weal.

Drouin was born in the old capital itself in July, 1862, so that the appearance of this sketch is almost coincident with his sixtieth birthday—of which we wish him many happy returns in advance.

Even at school young Drouin produced ample evidence of that ambition, determination, and adaptability which in later years contributed so largely to his success. He has never been anything if not versatile. He started life with his father in the retail grocery business, and at twenty years of age, upon his father's death, took charge of the estate. Subsequently he was largely instrumental in founding the firm now known as Drouin Freres, Limited, one of the most prominent wholesale grocery firms in Canada.

Mr. O. N. Drouin

As far as we in the constructional sphere are concerned, Napoleon Drouin's greatest work has been his part in the advancement of road construction. From the time he was associated with the work some years ago under the Gouin administration, the province of Quebec has witnessed the most vigorous progress in the construction of permanent roads—progress which has placed Quebec in the forefront of highway improvement—progress accomplished at a comparatively low cost, reflecting the greatest credit on those responsible for the supervision of the work and the financial arrangements made for it—and upon none less than the subject of our sketch.

Napoleon Drouin is the type of French-Canadian that remains the bulwark of that race—the big, broad, far-seeing type which concerns itself with the constructional development of Canada in its broadest and best sense.

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as a new cover complete would have to be installed, whereas in the case of the improved type, the cost of replacement would be confined to the cost of the labor necessary to turn the curb, estimated at $7.00, resulting in a net saving of $48.50 on the first replacement. In the case of the second replacement, the cost of the old type would be the same, $59.50, while with the new type there would be the labor cost as above $7.00, plus the cost of a new curb, $8.00, a total of $15.00 or a saving on the two replacements of $93.00. When this saving is figured on the total number of manholes in a city such as Chicago, where there are approximately 400,000, the great economic advantages of the new manhole cover may be realized.

Comparative tests were made of the strengths of the old type manhole base and the new curb and base. The weight of the former was 416 lbs. and the combined weight of the new curb and base arrangement was 316 lbs. The test consisted of dropping a 1200-lb. weight from various points, starting at a height of 6 ft. and increasing the distance 1 ft. for each drop until rupture occurred. The castings for both types of manhole cover were poured from the same ladle of metal. The tests showed that the new type reversible curb, though considerable lighter in weight, was actually stronger than the old type, the latter failing at the 10 ft. drop, while the former did not crack until the weight had been dropped from a height of 15 ft.

The Canadian Municipal Equipment Corporation, Toronto, who have the exclusive rights for the manufacture of this new type cover, have a plan whereby they propose to dispose of these rights to municipalities, who can then arrange for the manufacture of the cover in a local foundry.

Civic Officials at the demonstration of the new manhole cleaner and street flusher in Toronto.

Demonstration in Toronto of New Manhole Cleaner

A most unique demonstration of a new type of manhole cleaner, called the Otterson Auto Eductor was given in Toronto on Tuesday, May 2nd, in the presence of Street Commissioner George Wilson, councilmen and aldermen of the city and municipal representatives from Galt, Lindsay, Belleville and Guelph and several other provincial towns and cities. The demonstration took place on Elizabeth Street and it was necessary to call out the police reserve to hold back the dense crowd. In all, six catch basins were cleaned in an average time of two minutes each. The efficiency of the Auto Eductor was amply shown and those present expressed themselves as delighted with the thoroughness with which the machine did the work as well as the speed of operation.

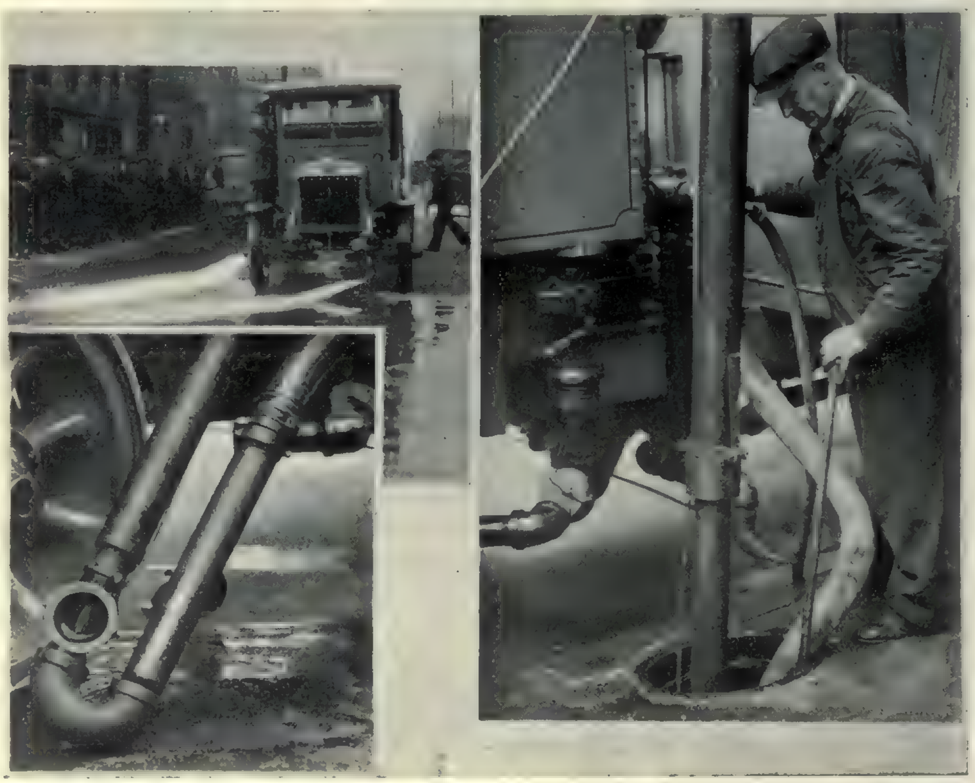
As a substitute method for the old time operation of scooping out the waste by hand and disposing on the pavement to be moved later by wagons, the Otterson Auto Eductor offers a welcome change, not only from the standpoint of economy and efficiency but for sanitary reasons.

A demonstration was also given the officials of the use of the machine in street flushing and sprinkling. Among those also present were Fire Chief Russell, Alderman McGregor, Riding, Winnett, Cowan, Denison and H. Rolland, representing Department of Health, Mr. James Sommers of the City Hall and George Powell, deputy city engineer.

Owing to the success of the demonstration given before the city officials, the company has been requested to turn the machine over to the city of Toronto under their own supervision.

Bulletin on Centrifugal Pumps

The Dayton-Dowd Company, Quincy, Ill., are distributing Bulletin 248 (superceding 245) on "Centrifugal Pumps." The bulletin is nicely illustrated and contains a quantity of practical information of interest to the engineering industry.



The Otterson auto-eductor which is a combination manhole cleaner, street flusher and sprinkler. These illustrations show features of the demonstration of this machine recently given in Toronto

Mainly Constructional

East and West—From Coast to Coast

Hundreds of families in the city of Brandon, Man., were forced to abandon their homes in the recent floods caused by the rising of the Assiniboine River. Whole sections of the city were under water and the damage done to property and crops will amount to a tremendous figure.

At a general meeting of the Montreal Builders' Exchange, held in that city recently, it was decided that a general reduction in wages in the building trades should be enforced, amounting to from ten to thirty per cent., the change to become operative at the beginning of the pay week nearest the first of June.

The construction company heretofore controlled by Mr. G. B. Reynolds, at Montreal, has been reorganized and incorporated as a limited company and will be known as Reynolds, Limited, with a capital of $50,000.

The bill to incorporate the engineers of the province of Ontario came up for discussion in the legislature a few days ago and after considerable debating, it was decided to let the measure stand over until the committeee appointed to consider it can take up with the engineers again certain clauses in the bill which members took objection to, among which was one providing penalties for non-registered men engaging in the practice of the profession. The general sentiment of the legislature was in sympathy with the principle of the bill to give engineers a recognized status, but the provisions referred to above were objected to in their present form by a number of the members, lead by Hon. W. E. Raney. The bill was introduced by A. W. Gray of Leeds, who readily agreed to a further discussion of the clauses in question.

Jno. V. Gray Construction Co. Ltd., general contractors, 541 Queen E., Toronto & 36 London St. W., Windsor, have opened new offices in the Bank of Toronto Chambers, London, Ont.

The new Prince Edward Hotel, at the corner of Ouellette Ave. and Park St., Windsor, Ont., is practically completed and will be opened in a few weeks time.

The city council at Ottawa recently decided to maintain last year's rate of 50 cents an hour for civic labor. This is 5 cents higher than the rate paid by the contractors for common labor.

A by-law granting the Dominion Alloy Steel Corporation, who are planning the erection of a huge factory in that city, a fixed assessment of $300,000 for ten years, was passed by the citizens recently. It is expected that excavation work will start some time next month. The entire cost of the plant is estimated at $5,000,000.

There are forty-eight graduates in engineering from Queen's University, Kingston, this year, or seven more than last year.

His Honor, the Lieutenant-Governor of British Columbia, Hon. W. C. Nichol, will officially open the ninth annual convention of the Canadian Good Roads Association, to be held at the Empress Hotel, Victoria, on June 12, 13, 14 and 15th. Hon. John Oliver, Premier of the Province, will welcome the delegates, who will include many prominent government officials, engineers, road contractors, etc.

The bill providing for a change in the rule of the road in Nova Scotia to "drive to the right" passed its third reading in the House of Assembly recently and was passed on to the Legislative Council. The bill provides for the inauguration of this new law on January 1, 1923. It is stated that New Brunswick also has a movement to enforce the same change in the rule of the road.

The Harbor Commission at Montreal has been granted a further loan of $5,000,000 by the Department of Marine & Fisheries, to finance the construction of terminal facilities in the harbor of Montreal.

Union painters and decorators at St. Catharines, Ont., who have been out on strike, returned to work recently, having accepted a reduction of five cents per hour, the new wage agreement calling for 65 cents per hour. One dispute remains for settlement, the plumbers still being out.

Personal

Mr. A. W. Swan, of Montreal, has resigned as assistant general secretary of the Engineering Institute of Canada, and sailed recently for England where he will take up permanent residence. Mr. Swan has been connected with the Institute's Journal for some time, in charge of editorial work, previous to which he was connected with the Ingersoll-Rand Company, at Sherbrooke, Que. He came to this country several years ago.

Mr. A. B. Normandin, engineer of the Hydraulic Service of Quebec, addressed the members of the Quebec branch of the Engineering Institute of Canada at their final luncheon of the season, held recently at the Frontenac Hotel, Quebec. He spoke on water systems and the use of hydraulic forces.

Mr. A. E. Chapman, roofing contractor, of 55 Aldridge Ave., Toronto, has purchased the business of The Danforth Roofers, and will operate both concerns under the name of The Danforth Roofers, with head office at the above address.

Mr. H. Sandison, of Winnipeg, was appointed chairman of the Clean-Up Campaign committee, which has charge of the city-wide campaign that opened in Winnipeg on May 6 in an endeavour to secure the co-operation of the citizens in general in an extensive program of cleaning up and painting those parts of the city which were badly in need of brightening up.

Mr. C. B. McDougald, of Truro, N. S., has been appointed manager of a new road construction company recently organized in Digby, N. S., to be known as Nova Scotia Road Builders Company. Other members of the new firm are Messrs. M. C. Denton, of Digby; M. A. Condon, of Kentville, and J. W. Salter, of Bridgetown.

New Companies

E. W. Herring, Limited, with head office at Montreal, capital $49,500, to carry on the business of general contractors.

Adanac Construction Co. Ltd., with head office at Montreal, capital $50,000, to carry on the business of contractors and builders.

Economic Building Store, Limited, with head office at 1673 Papineau St., Montreal, capital $250,000, to carry on the business of builders and to deal in building supplies.

Fibre Asphalt Products, Limited, with head office at Toronto, capital $500,000, to deal in paving materials and machinery.

Albion Paving & Construction Co. Ltd., to carry on the business of contractors and engineers, with head office at Hamilton, capital $150,000.

W. R. Hughes Co. of Canada, Limited, with head office at Toronto, capital $50,000, to manufacture and deal in paints, oils, varnishes, etc.

CONSTRUCTIONAL ACTIVITY

Period of May 10 to May 16, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Essex, Ont.
Town Council contemplate construction of concrete pavements on Cameron and Wilson Aves. and Victoria St.

Town Council plan laying new watermains on Russell, Medora, Maidstone and Talbot Sts.

Fredericton, N. B.
Tenders will be called for construction of watermains on Woodstock Rd., Aberdeen, Westmoreland and Victoria Sts. to cost $25,000 for City. G. C. McDowell, Engr.

Levis, Que.
Hon. J. L. Perron, Min. of Roads, Quebec Prov. Gov't., will receive tenders until May 29th for macadamazing section of Levis-Jackson Highway within St. Henri Village, St. Henri de Lauzon and St. Louis de Pintendre Parishes, and Levis, (10¼ miles). Plans with Dep't.

Listowel, Ont.
Town Council plan construction of permanent pavements on Division, Bismarck and Main Sts.

Londesboro, Ont.
Jno. Fineland, Londesboro, clerk Hullet Twp. Council, has plans and will receive tenders until May 26th for construction of the Carter Municipal drain and completion of the Kinburn drain.

Montreal, Que.
City Council plan continuance of St. Joseph Blvd. from Papineau east. S. Fortin, Engr.

Hon. J. L. Perron, Min. of Roads, Quebec Prov. Gov't., will receive tenders until May 30th for renewing macadam pavement on Montreal-Ottawa Highway in L'Abord a Plouffe, St. Dorothe and west part of St. Rose. Plans with G. Henry, Engr. Roads Dep't., Parliament Bldgs., Quebec.

Nelson, B. C.
City Council plan construction of pavements at cost of $60,000 on various streets. T. J. McGuire, Engr.

New Westminster, B. C.
Construction of roadway at cost of $24,000 from City boundary line to Coquitlam Dam, 12 miles, is contemplated by City Council and B. C. Electric Ry.

Oakville, Ont.
Town Council contemplate installation of auxiliary gasoline engine and pump at cost of $32,000. Chipman & Powers, Engrs., Mail Bldg., Toronto.

Palmerston, Ont.
H. Hyndman, Town Clerk, has plans and will receive tenders until May 22nd for paving Main and William Sts., at estimated cost of $25,000. Plans also with A. W. Connor, Engr., 34 Victoria St., Toronto.

Port Credit, Ont.
Gore, Nasmith & Storrie, Engrs., Confederation Life Bldg., Toronto, are preparing plans for waterworks system which will include pumping station, filter beds, concrete storage reservoir, overhead tank, 5 miles of watermains and intake pipe. Tenders will be called shortly.

St. Anne de Beaupre, Que.
Construction of macadam road is contemplated by County Council. G. Henry, Engr., Roads Dep't., Prov. Gov't., Quebec.

St. Catharines, Ont.
Chrm. Bd. of Works will receive tenders until May 25th for construction of sewers and pavements for City. Plans with W. P. Near, Engr. Marked cheque for 5% of tender required.

St. Johns, Que.
City Council are constructing surface water and house service drain at cost of $15,000 on St. James St. by day labor. L. W. Bourassa, Engr.

Sherbrooke, Que.
A. C. King, Purchasing Agent, will receive tenders for street paving and concrete sidewalks for City. Plans with Thos. Tremblay, Engr.

Thorold, Ont.
Town Council contemplate laying a 24" watermain from basin to standpipe, distance of 3 miles. F. N. Rutherford, Engr., Queen St., St. Catharines.

Truro, N. S.
Town Council plan construction of sewers on Broad, Willow, Arthur and South Young Sts. H. McDougall, clerk.

Warwick Twp., Ont.
Twp. Council will construct new drain and will also repair Kilmer, Higgins and Clark drains. N. Herbert, clerk, Watford, Ont.

Welland, Ont.
W. A. Swayze, Chrm. Welland County Council will receive tenders until May 24th for construction of bituminous penetration pavement in several sections of the county. Plans with County Rd. Sup't. Certified cheque for 10% required.

West Luther Twp., Ont.
W. W. Duncan, clerk West Luther Twp., Damascus, has plans and will receive tenders until May 27th for construction of drain. Marked cheque for 10% of tender required.

CONTRACTS AWARDED

Hagersville, Ont.
General contract for construction of concrete sidewalks for Town Council is awarded to Conery & Robinson, 38 Yorkshire St.

Jerseyville, Ont.
General Contract for construction of 4 miles of asphalt pavement for Prov. Gov't., Dep't. Pub. Highways, is awarded to the Provincial Contracting Co., 24 Adelaide W., Toronto.

Lachine, Que.
Leger & Charlton Ltd., Lachine, have general contract for construction of asphalt concrete pavement costing $14,000 on Notre Dame, 6th, 10th and 18th Aves. for Council. A. Laframboise, Engr.

Lindsay, Ont.
G. H. Lindsay has general contract for construction of granolithic sidewalks for Town Council.

St. Thomas, Ont.
General contract for construction of asphaltic concrete pavements on Mary, Mitchell and Hiawatha Sts. for City is awarded to Standard Paving Ltd., Central Chambers, Ottawa. W. C. Miller, Engr., St. Thomas.

Welland, Ont.
Welland County Council awarded following contracts for roadwork: Sec. A. & C., Jno. Pierson, Stevensville, Ont., at $8,490 per mile; Sec. B., E. G. Law, 107 Hillsdale Ave., Toronto, at $6,000 per mile, also Bertie Roads at $15,750 per mile; Sec. E., Dufferin Construction Co., Brass Bldg., Toronto, at $7,500 per mile; Fenwick Roads at $13,990 per mile, to Archibald Construction Co., 122 Delaware Ave., Toronto.

Railroads, Bridges and Wharves

Deschambeault, Que.
Tenders will be called for alterations to wharf to cost $70,000 for Dom. Gov't., Dep't. Pub. Works. J. B. St. Laurent, Chief Engr., Ottawa.

Grondines, Que.
Plans are being prepared for repairs to wharf for Dom. Gov't., Dep't. Pub. Works. J. B. St. Laurent, Chief Engr., Ottawa.

Regina, Sask.
Hon. H. S. Carpentier, Deputy Min. Dep't of Highways, Regina, has plans and will receive tenders until May 29th for (A) 2-60 ft. concrete arches, South of Drinkwater. (B) 20 ft. concrete beam span, West of Yorkton. (C) 40 ft. concrete beam span, East of Maple Creek. Accepted cheque for $250 required with each tender.

St. Anne des Plaines, Que.
D. Gauthier, secy.-treas., has plans and will receive tenders until May 27th for construction of iron bridge. Plans also with I. E. Vallee, Engr. Pub. Works Dep't., Prov. Gov't., Quebec.

St. Antoine de Tilly, Que.
Tenders will be called for repairs to wharf to cost $10,000 for Dom. Gov't., Dep't. Pub. Works. J. B. St. Laurent, Chief Engr., Ottawa.

St. Malachie, Que.
Geo. Lafontaine, secy.-treas., has plans and will receive tenders until May 23rd for construction of metallic bridge, concrete abutments and approaches. Plans also with Pub. Works Dep't., Quebec.

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Greater Uniformity in Building Codes

Lack of uniformity in municipal building codes is causing tremendous waste and confusion. It causes waste because many of the codes permit materials to be loaded only to a point far below their safe carrying capacity, while confusion results because contractors operating in different centres are unable to adopt standards of practice that are acceptable in all cities alike. In addition to lack of uniformity, other defects are also evident in building codes. Many, for example, are inadequate in their scope, failing to cover many of the types of construction that are now recognized and accepted as standard. Not a few are out of date, their clauses failing to embrace the facts which recent investigations into the behavior of structural materials have brought to light. Further, by-laws or portions of them are frequently inapplicable inasmuch as they were compiled without thorough knowledge of the scope and purpose of a building code and without sufficient recognition of local conditions.

To remedy these last three defects and others akin to them is the duty of each individual municipal authority but the attainment of uniformity is a matter for concerted action. Educational effort must play a large part in convincing towns and cities of the need and demand for an element of uniformity, and it is here that contractors may help very effectually. Their organizations should press the matter of a uniform code very hard and by a proper propaganda strive to convince municipal officials of the need of a reform along this line.

It is remarkable what discrepancies there are in the codes of this country. The wide variations in typical requirements is indicated in an article in this issue, by R. G. Kimball, whose organization, the National Lumber Manufacturers Association, has done much to urge standardization of building by-laws. While Mr. Kimball's figures are derived as a result of United States investigations, the conclusions derived are applicable to almost the same extent in Canada.

A reform in the building code situation will certainly be welcomed by all architects, engineers and contractors in Canada. With conditions as they are at present, endless confusion is caused by those who carry on a construction business in more than one municipality. A more important result of lack of uniformity, however, is the fact that the majority of codes do not permit materials to be stressed to anywhere near their capacity. In many instances, the permitted stress is but a small fraction of the safe loading stress. Enormous waste of material is the result and with such waste, costs of building are, of course, increased. Therefore, building code revision is a means of cutting construction costs.

Highway Improvement in Saskatchewan

The amount of money voted by the Saskatchewan Legislature for Public Improvements for the 1922 season is: Chargeable to Revenue, $1,180,932.00; Chargeable to Capital $855,000.00; total $2,035,932.00. This is a decrease of some $300,000.00, of the amount voted in 1921.

Highway Construction

It is estimated that about $900,000.00 will be required to complete the contracts entered into last season and those contracts which will be called for this spring for the construction of provincial highways under "The Canadian Highways Act." The type of road approved under this act is an earth road 20 feet wide exclusive of side ditches. The above amount will include the construction of some small concrete bridges and the installation of culverts, both reinforced concrete and steel. The maintenance of about 300 miles of highway completed during the season of 1921, will be under the direct control of the Department this season.

Large Steel and Concrete Bridges

It is estimated that a sum of $120,000.00 will be required for large bridges of permanent type, viz reinforced concrete bridges of arch or beam type, or steel trusses on concrete foundations. These bridges will be located on main lines of travel serving some market centre, and will replace old and weak bridges inadequate for present traffic. Public tenders are called for the construction of these concrete bridges and abutments in the months of April and May, and the construction is carried on through the summer months; the orders for steel spans are placed about the same time, erection of these spans take place in late summer and fall months by departmental bridge crews. These bridges are designed and plans issued by the engineering branch of the department.

Main Market Roads

For the construction and maintenance of main market roads, some $550,000.00 will be required. The work handled under this expenditure is road construction work undertaken by the rural municipalities under contract with the department, and some works by day labor gangs employed directly by the department in districts where the organization of the municipality is not sufficient to carry out the work. These contracts and jobs run from $200.00 to $2,000.00. Part of the $550,000 is also spent in assisting the rural municipalities to efficiently maintain their main market roads in a systematic and economical manner, the government giving a grant on the basis of $500.00 to each municipality of nine complete townships. Assistance is also given to the rural municipalities for the construction of timber bridges of a longer span than 16 feet; the majority of these bridges are pile bridges and all are of Saskatchewan government standard design. The construction of these bridges is undertaken by bridge crews organized by the department, the department supplying materials.

Discontinuance of the Road Drag Competition

This season the department is holding no "Road Drag Competition," not because of the non-success of the previous competitions, (the number of entries for the last competition compared very favorably with the previous years) but it was considered that the educatory influence had been fully accomplished by the competitions, and the money set aside for prizes could be better utilized to augment the money allotted for direct maintenance of roads.

Other Services

In addition to the above, certain supplementary services are taken care of out of the main vote, such as:—the operation and maintenance of some forty-four ferries, owned and operated directly by the Government, (these ferries are free between the hours of 7.00 a.m. and 8.00 p.m., a small toll is charged after hours;) the ploughing of certain public fireguards in the ranching areas; securing water supply for cattle watering and threshing purposes in districts where the supply is limited, by the construction of dams and dug-out reservoirs, surveying and establishing diversions from the regular road allowance and new roads, etc.; organizing drainage areas and undertaking the engineering work in connection, letting the contracts for these works and supervising the works during construction.

Standardization of Hose Couplings

Uniformity of Diameter and Threads is Desirable—Simplest and Least Expensive Method is to Use Adapters—Large Threads Preferable to Fine Threads

By **NORMAN R. WILSON**
Chief Engineer, Brantford, Ont., Water Works

Before the Canadian Section of the American Water Works Association

The question of standardization of hose couplings is constantly being brought to the front with regard to fire departments but the writer has seldom heard it mentioned by water works officials. There is no doubt, however, that it would be a good thing to have all couplings standardized with regard to new water works installations, especially in the western provinces where there are so many new towns which are and will be going into the question of the installation of water works and fire protection in the future.

The writer has on many occasions been asked why it is that there are so many sizes of couplings. The answer is a very simple one. The first protection in case of fire engines was by hand operated appliances, made locally, and each maker had his own threads and sizes to work to, usually cutting his own dies. Then came the steam fire engines and the makers of these made their connections to fit the various hose couplings in use. In the same way when water works systems were introduced hydrant couplings were made to conform to the various existing hose couplings.

From a practical point of view, the cost of altering all couplings to conform to a common standard would be so great a tax on the municipalities already equipped that such a thing would be absolutely impossible. Take, for instance, the city of Toronto with 6,833 hydrants, the cost of changing the hydrants alone would be in the neighborhood of $35,000.00, taking the cost of altering each hydrant as $5.00. In addition to this, of course, there would be the cost of altering all hose couplings and providing new caps for the hydrants.

The question would also come up which department would have to pay for such alteration, for though the hydrants are under the control of the water works department the chief object for altering would be for fire protection. Again, the question arises as to what is the best standard to use. It is generally conceded that the best size of clear opening is the present standard of 2½ inches, which brings the question down to two points, namely, outside diameter of thread on the male coupling and the number of threads per inch. At present the diameters range from 3 inch to 3¼ inch, and the threads per inch from 5 to 8.

A few years ago an investigation was made in the United States, when it was found that in the majority of municipalities the outside diameter was about 3-1/16 inches and the threads per inch from 7 to 8. To suit these a standard was adopted having 3-1/16 inches outside diameter and 7½ threads to the inch. Such a thread, in the opinion of the writer, is not a suitable one. In case of a fire the chief object is speed, and so small a thread is very liable to cause delay by cross threading. This very frequently occurred when the writer was conducting speed tests. The larger the thread the less liability there is to cross threading and the writer has no hesitation in stating that in his opinion the best thread to use is 5 to the inch. With such a thread there is practically no chance of cross threading and it can readily be attached both in the dark and in the winter.

The simplest and least expensive method for existing municipalities to adopt in order that they may render assistance to each other in case of necessity and one which the writer induced many municipalities to adopt is to require each municipality to have on hand adapters which will enable it to connect with the surrounding municipalities within a certain radius.

Three Million Dollars Spent on Sewer Schemes for Vancouver District

A Review of the Progress Made to Date by the Vancouver and Districts Joint Sewerage and Drainage Board in the Development of a Comprehensive Sewer Layout

It is practically ten years since the initial steps were undertaken, which have borne fruit in the works carried out by the Vancouver and Districts Joint Sewerage and Drainage Board, to give it the full present-day official title. The original title was Burrard Peninsula Joint Sewerage Board, so named in the first bill passed by the provincial legislature in March, 1913, bringing the Board into existence. A year later the name was changed by a new act, and the board has since carried on under the new title. The inception of the Board followed the work of a joint committee of representatives of the city of Vancouver and the adjacent suburban municipalities of Point Grey, South Vancouver and Burnaby. This committee had been formed to look into the whole question of the sewerage construction necessary for the metropolitan area of what is popularly called in western phrase, "Greater Vancouver." The date of the formation of this committee was in 1911, though much earlier than that time, it had been impressed on the civic and municipal councils that some common plan for the sewer construction of the entire area would have to be adopted in order adequately to meet the development of population in the city and its suburban environs.

As an immediate result of the formation of this joint committee, arrangements were made whereby the city of Vancouver financed the necessary outlays on preliminary investigations, pending the formation of a permanent commission. Almost at once it was decided to call in Mr. R. S. Lea, consulting engineer, of Montreal, an acknowledged authority on sewerage problems. That gentleman was retained in June, 1911, and at the first of 1912 Mr. A. D. Creer came to Vancouver as his associate in the work of collecting data, making preliminary surveys and investigations, collating engineering estimates and preparing a report on the project. From that time on, organization proceeded steadily until the creation of the Board by act of legislature. The powers granted the new board by that act were based upon the estimates in the final report of the consulting engineer, which placed the cost of the entire scheme advised by Mr. Lea, at $11,000,000. Half of this amount, it was estimated should be expended on construction of progressive nature in the time immediately following the date at which the Board began to function. In the next twenty-five years, it was estimated by Mr. Lea, the second half of the estimated capital expenditure should all be made, keeping pace with the development of the communities in the area covered by the plans advised.

First Ten Years' Progress

To review and summarize the progress made by the Board in carrying out the sewerage and drainage schemes for which it was formed will be the object of the following paragraphs. It may be stated here that the total capital expenditure so far made has been, roughly speaking, $3,000,000, which is rather more than half of the $5,500,000, which in Mr. Lea's opinion, as expressed in his original report, should be devoted to immediate sewer needs for the area as it has been developed up to the present time. No comment is necessary on this curtailment of enterprise in view of the financial situation as well as the economic condition of this and every other country in the past seven years.

In Mr. R. S. Lea's original report the area and topography of the district to be served by the completed scheme was described briefly. Vancouver city covers 9,250 acres, South Vancouver, 8,900 acres,

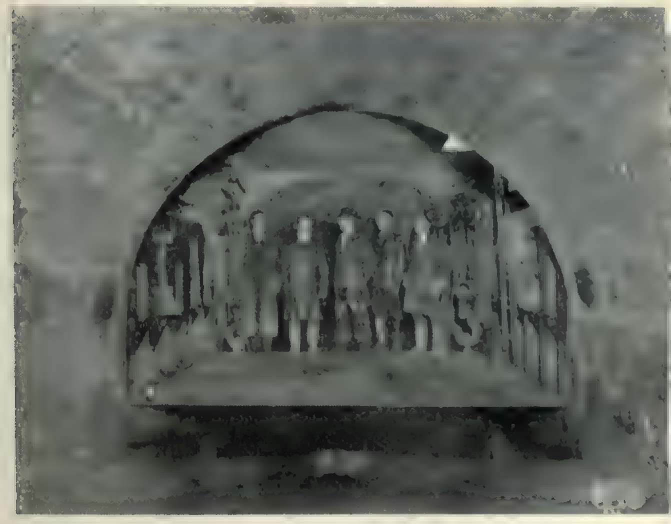


Fig. 1—Clark Drive interceptor, with Concrete slab "separator" to divert overflow to False Creek outfall over top of slab, here shown raised. Clark Drive interceptor takes its full capacity under slab

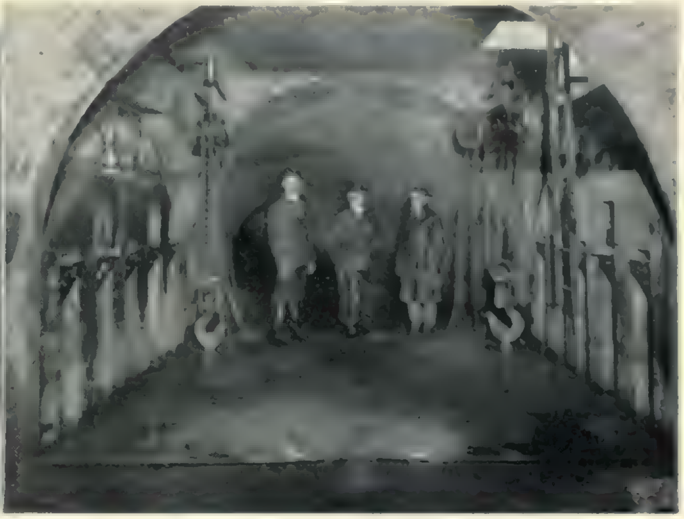


Fig. 2—Clark Drive interceptor, with concrete slab lowered, the entire flow being thus diverted to False Creek outfall. This is a unique feature of sewer construction design

Burnaby, 22,200 acres and Point Grey, 12,400 acres, a total of 52,750 acres. Added to this is the area of New Westminster city, 2,850 acres. This latter unit is not included in the schemes of the Board, but owing to the configuration of the portion of Burnaby adjacent to the Royal City boundaries, there will require to be a measure of co-operation between the Board and the city, when it comes to the point of completing the development of the Fraser River drainage area. The area is roughly peninsular, bounded by Burrard Inlet (Vancouver Harbor) on the north and by the North Arm of the Fraser River on the south. The westerly portion of the peninsula is divided by False Creek, an arm of the sea running easterly from English bay, which is the westerly boundary of the area. The area thus defined is divided into drainage areas easily outlined, by three main ridges, two running east and west and one north and south, the latter uniting the other two, and the height of land taking the form of a letter "H" on its side. The first ridge runs in general parallel to the shore of the Inlet from Port Moody to Stanley Park. The second runs parallel to the first and also to the Fraser River and extends from the eastern boundary of New Westminster near the Brunette River to the extreme western end of Point Grey. The third ridge runs south from Hastings Park and connects the first two. In his original report Mr. Lea named the five natural drainage areas formed by these ridges by the natural places of discharge. With their respective acreages they are:

Burrard Inlet	4,800 acres
False Creek	7,400 „
English Bay	5,950 „
Fraser River	17,600 „
Burnaby Lake	17,000 „
	52,750 „

Subdividing these main drainage areas according to the surface contour of each district, signed plans showing the final arrangement of the entire area are on file in the Land Registry Offices. These are:

A—Whole sewerage district
  B—Balaclava area
  C—Bridge Street area
  D—China Creek combined area
  E—China Creek separate area south
  E1—China Creek separate area north
  F—Clark Drive interceptor area
  G—Burnaby Lake interceptor area
  H—Hastings Park area
  K—Burnaby Lake area

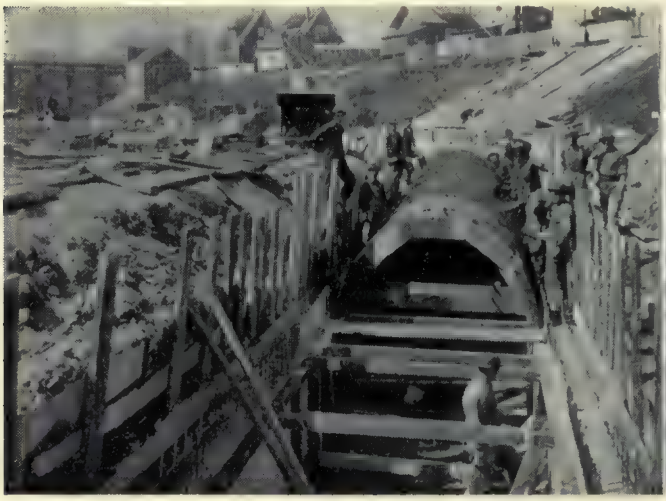


Fig. 3—China Creek trunk sewer—building reinforced concrete over forms in place

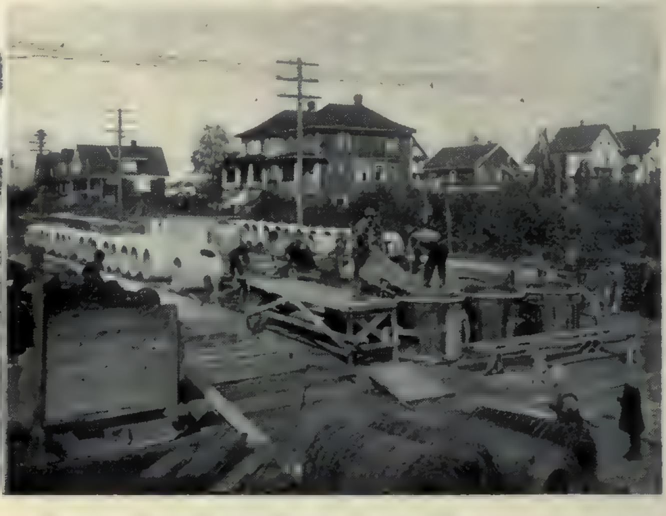


Fig. 4—Making reinforced concrete sewer pipe on the work, during sewer construction

According to the recommendations in Mr. Lea's report, adopted by the Board it was proposed to construct as main features of the sewerage work:

(a) An interceptor along the south shore of English Bay from Imperial Street to Bridge Street, with necessary outfall works and trunks.

(b) An interceptor along Clark Drive from Seventh Ave. north to Burrard Inlet, with necessary outfall works and trunks.

(c) An interceptor south of Still Creek and Burnaby Lake, discharging to the Fraser River.

(d) Various trunks on the south slope of the peninsula discharging into the North Arm of the Fraser.

(e) A West End interceptor and outfall discharging beyond Brockton Point (Burrard Inlet) and a trunk and outfall in Hastings Townsite.

(f) Improvement works, Brunette River (outlet of Burnaby Lake) and Still Creek (flowing into Burnaby Lake.)

Description of Works

The first work undertaken by the Board was the Canoe and China Creek extensions (Vancouver city had by arrangement already completed a portion of this system.) Tenders were called for, but were finally all rejected and the work done by day labor. In the report prepared by the Board's chief engineer, this work is described in these words: "Monolithic type of construction was adopted, reinforced concrete being used in open trench, and plain concrete in tunnel work."

Following is a list of the chief works so far completed since the Board undertook active development of the adopted plan of sewer for the metropolitan area of Vancouver and its suburbs:

(1) Canoe Creek extension—6 ft. 6 in. diameter in circular section reducing to 5 ft. and then to 4 ft. 6 in. and 4 ft. Total length 2,800 feet, of which 1,700 feet was in tunnel and nearly 1,100 feet in trench of an average depth of 19 feet.

China Creek extension, 8 ft. 6 in. diameter, standard horseshoe section, reducing to 5 ft. 6 in. and later to 4 ft. 6 in. to a chamber into which 3 ft. 6 in. and 3 ft.

branches have outlet. Average depth of trench 13 feet; construction, reinforced concrete. Total length, 3,008 feet.

(2) Extension of China Creek main eastward to Burnaby—6 ft. 6 in. diameter, reducing to 4 ft. 3 in. then to 3 ft. 6 in. and with branches of pipe construction reducing to 1 ft. 3 in. The feature of this section was the tunnel under Cedar Cottage nearly 2,800 feet in length, 6 ft. 6 in. horseshoe section, the concrete for which was shot into place by compressed air. Some 80 test holes were cut in the sides and crown after completion and in every case the concrete was found to be dense and solid with all cavities in the excavation filled. Total length, 25,986 feet.

(3) Balaclava Trunk extension—standard horseshoe section, 8 ft. 6 in. diameter partly in trench and partly in tunnel. This main terminated in a junction chamber built as outlet to a 4 ft. 3 in. and a 3 ft. 6 in. branch. A 6 ft. branch is a part of this trunk, reducing to 4 ft. 6 in. and later to 4 ft. Total length, 6,673 feet.

(3a) 10th Ave. extension, connection to Section (3)—3 ft. 6 in., 4 ft., and 4 ft. 6 in. diameter partly in open cut and partly in tunnel, total length 2,889 feet. A feature of this work was the laying of a ten inch diameter sewer pipe on the top of the sewer to take house connections, effecting a great saving in cost to the city.

(4) Brunette River improvement—This consisted of deepening the bed of the river commencing at a point some 6,000 feet below the outlet of Burnaby Lake and extending to within 1,000 feet of the outlet; and building a permanent dam at the outlet of the lake to control the lake level. This dam is made with concrete cut-off wing walls, with 12 in. x 12 in. stop logs which can be raised to let flood water down the channel of the river.

(5) West End Interceptor, from English Bay to north shore of Stanley Park, cutting off existing sewers discharging into English Bay and Coal Harbor and carrying the flow out to the Narrows. It was originally intended to confine the capacity of this interceptor to only dry weather flow, but by arrangement at the city's representation the capacity was increased to take care of storm water, except an extraordinary rain storm.

As the city was contemplating construction of the Coal Harbor Causeway, it was suggested that a saving would be effected by carrying the sewer in the concrete causeway wall. A design was agreed upon by the Board's chief engineer and the city engineer, and the section of 888 feet of 4 ft. 5 in. sewer was thus built. The other sections were built in 1917 and 1918. The sewer starts English Bay with a 3 ft. 6 in. tunnel section, thence with circular 3 ft. 6 in. section through the fill to the causeway where the 4 ft. 5 in. diameter commences, continuing to the outfall, 22 feet below low water in the Narrows northeast of Stanley Park.

(6) Clark Drive Interceptor, to cut off sewage flow from the large natural drainage area at the head of False Creek and carry it out to Burrard Inlet. Between the time of preparing the report and the construction of Clark Drive Interceptor the part of False Creek east of Main St. had been acquired by the Canadian Northern and Great Northern Railway Companies, under agreements which contained clauses obligating those companies to take care of storm water flow. The Clark Drive interceptor was therefore designed to carry all sewage and ordinary rainfall out to the Inlet. In his report from which much data has been obtained, Mr. A. D. Creer, chief engineer defined that ordinary rain storms meant a rainfall intensity of under a quarter of an inch per hour on a drainage area of 2,300 acres, calculated for a future maximum population. At present the interceptor is handling even the heaviest rainstorms. To provide for the future, however, the flow from the China Creek sewer is diverted into the interceptor at a point where an 8 ft. 6 in. storm sewer outlet to False Creek begins, by means of a movable invert slab of concrete and steel, which when lowered is flush with the invert of the trunk sewer. In its raised positions the steel and reinforced concrete tongue diverts the lower portion of the flow into the interceptor, the upper portion of the flow going down the sewer outlet to False Creek, where the trunk sewer constructed by the railway company takes care of it. The separator can be set to take care of any portion of the flow up to the full capacity of the interceptor.

The outfall for the interceptor into Burrard Inlet is a 6 foot diameter shaft, 51 feet deep and a 6 ft. tunnel of special section, 1,549 ft. long. There was also a construction shaft which was lined with concrete and covered with an iron plate. The interceptor is constructed throughout of reinforced concrete in trench and plain in tunnel, with brick and vitrified tile inverts.

(7) Hastings Park Area—a trunk sewer 6 ft. 6 in. section, changing to 4 ft. 6 in. x 6 ft. in trench, reducing to 5 ft. branching east and west, the east branch ending at the boundary of Burnaby and the west branch continuing to Turner and Nootka St. Total length, 10,549 feet, much of which is in tunnel, and reducing from 6 ft. 6 in. to 4 ft. and 3 ft. 6 in.

(8) Bridge trunk sewer extension—a 5 ft. 6 in. special section trunk, reducing to 4 ft. 6 in., serving Fairview and western portion of Mount Pleasant, south of False Creek. Construction is of reinforced concrete. It was built in open trench. The total length was 2,800 ft., 1,600 ft. of the larger size and 1,200 ft. of the smaller. An interesting point in connection with this work was that the engineer's estimate of cost was $62,700. Tenders were called, the lowest being $81,000. The work was carried out by day labor under the supervision of the engineer at total cost of $61,000. At Mr. Creer's representation, the Board distributed the $1,700, surplus between the superintendent, foremen and the workmen employed.

(9) Balaclava trunk sewer extension—This is an 8 ft. diameter trunk, reducing to 4 feet at the upper end. It was built of reinforced concrete throughout. The work was of some considerable extent, 9,500 feet in all, steam shovel and locomotive crane being used in the excavation. This is the latest unit of the general scheme of any importance to be carried out by the Board.

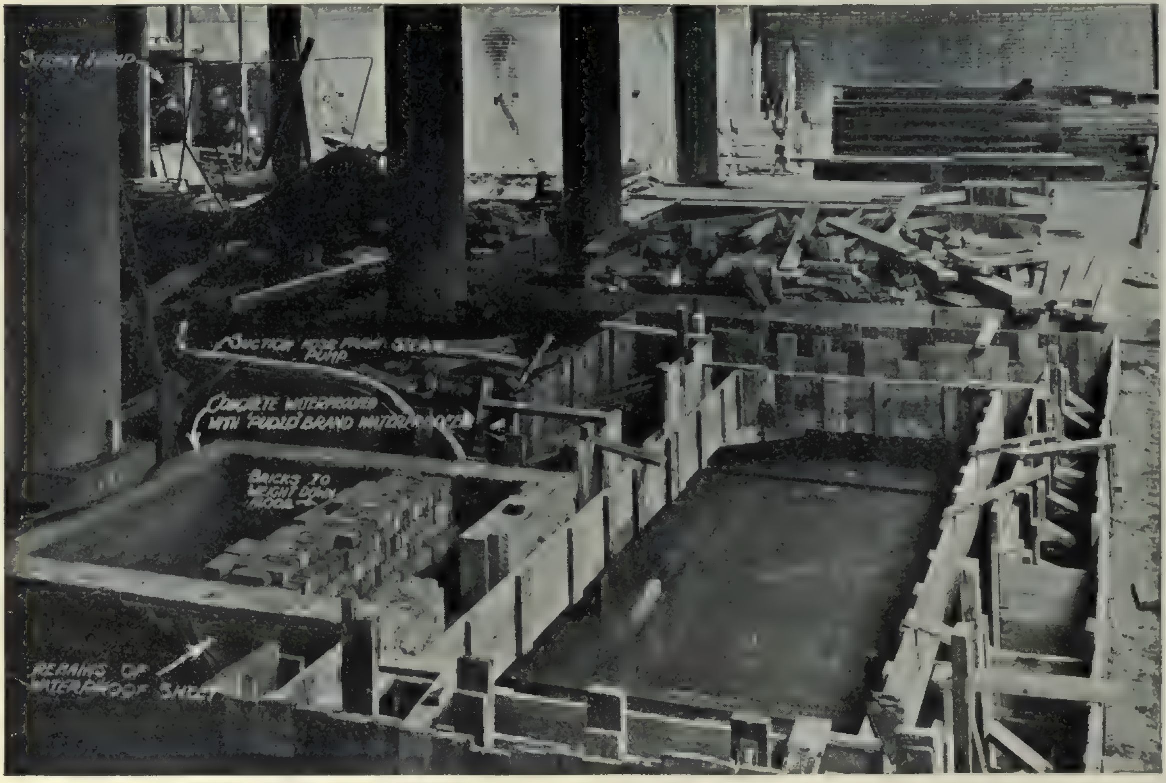
Possibilities for the Future

On the whole, the comprehensive plans formulated and in part already carried to completion since the foundation of the Sewerage Board have worked well for Vancouver and the sister municipalities. There may have been some mistakes, and there is opportunity for improvement in some features of the organization. Planning for the future of this western port of Canada has been the motive to a large extent in the organization of this ambitious system of sewerage. With an eye to the expansion which is assured to the metropolitan area of Greater Vancouver, Mr. A. D. Creer, former chief engineer in charge of the work, expressed the view that the original scope of the Vancouver and District Board could with great propriety, and certainly with great benefit, be very much enlarged. Just as the sewerage problem has been successfully handled for the entire area under one authority, other public utilities and services, such as the water, light and power supplies, the construction of roads, even the policing and fire protection, could with advantage be brought under a Board with enlarged powers. It would in short, become a sort of County Council, on lines similar to the London County Council, which so efficiently handles the public services of the capital of the British Empire. Such an enlarged body might well become elective and take on the powers of a real commission.

An Interesting Concrete Waterproofing Contract

Spielman Agencies, Regd., send us a description of an interesting piece of construction work at Southwark, England, on the bank of the Thames, in which Pudlo to the extent of 3 lbs. to every 100 lbs. of cement was used to form an integral waterproof concrete. The site of the building is within 150 yards of the river Thames and the floor level of the basement is 10 ft. below high tide level. Difficulties were encountered during the placing of the foundation owing to water percolating through the gravel subsoil. This was further complicated by the necessity for providing inspection pits 5 ft. below the general basement floor line. The method adopted was to form these pits of reinforced concrete and to waterproof the concrete integrally as already noted, with Pudlo. Several of these pits have been completed, with satisfactory results.

An interesting feature of the work was that, owing to the heavy pressure of water which percolated through the gravel subsoil, it was necessary to take precautions to prevent the washing away of cement before its initial set had taken place. On the bottom of the finished excavation a waterproof sheet was laid, the edges being turned up so as to form a tray; the concrete was then deposited in this tray. A steam pump was kept continually at work, the suction end of the hose being placed in the sump outside of the pit. After the floor of the pit had properly set, bricks to the number of 2,500 were placed upon it to weight down the structure and prevent its being thrust upward by the pressure of water. Necessity for the use of the waterproof tray arose from the extreme pressure and free percolation of water through the gravel upon which the pits were constructed; it was found impossible to localize the flow of water in the sump and there was danger that the cement would be washed out of the concrete and seriously weaken it.


SUCTION HOSE FROM STEAM PUMP
CONCRETE WATERPROOFED WITH 'PUDLO' BRAND WATERPROOFER
BRICKS TO WEIGHT DOWN FLOOR
REMAINS OF WATERPROOF SHEET

On this job special precautions had to be taken to prevent washing away of concrete before its initial set

Canadian Water Works Officials Meet in Brantford

Two-Day Convention at Which Several Interesting Papers Were Presented—These are Reprinted Elsewhere in this Issue—Exhibition of Equipment

The Canadian Branch of American Water Works Association met in annual session at the Kerby House, Brantford, on Friday and Saturday, May 12 and 13 last. The first session of the meeting commenced promptly at 2 p.m. Friday, with Mr. R. C. Harris, retiring chairman of the branch, in the chair. The first item of business following a few inaugural remarks by the chairman, was the reading of a lengthy paper on "Government Control of Sewage," by Mr. F. A. Dallyn, chief sanitary engineer, Department of Public Health, Ontario, which is published elsewhere in this issue.

In the discussion which followed the reading of Mr. Dallyn's paper, several of the members took part, Mr. James Milne, of the Works Department of Toronto, stating that he did not think the onus of blame for the pollution of the city's water supply should be placed upon the city, when this condition was brought about by the disposal of industrial trade waste.

The secretary-treasurer of the branch, Mr. C. D. Brown, of Walkerville, then read a paper, prepared by Mr. Clark Keith, chief engineer of the Essex Border Utilities Commission, on "Water Supply in its Relation to Sewage Disposal," dealing with the situation with regard to these problems in eight border municipalities of Ontario. This interesting paper is printed in full elsewhere in this issue. Mr. Brown wih the asistance of a detailed map of the district served by this sewage system, clearly explained the working of the system to the meeting. The one weakness which had been found in the system, he explained, was that it depended solely on Niagara power to keep the interceptors clear.

Election of Officers

The chairman then called on Mr. Milne, chairman of the Committee of Scrutineers, for the report of his committee. The report proposed the following list of officers for the coming year, the selection finding unanimous favor with the members: Chairman, R. L. Dobbin, of Peterborough; vice-chairman, F. C. Dallyn, of Toronto; secretary-treasurer, C. D. Brown, of Walkerville, (re-elected); trustee, R. H. Starr, of Orillia.

At this point in the proceedings, Col. Thoe. I. Leisen, a past president of the parent association, dropped in on the meeting, and spoke briefly to the members, expressing his pleasure at the opportunity of taking part in the proceedings of the meeting and hoping for an even greater degree of friendship and unity between the Canadian and American sections of the association. Col. Leisen was accorded a warm welcome by the chairman, who joined with him in hoping for closer relationship between the Canadian and parent bodies.

Mr. R. L. Dobbin, read a brief paper on the history of the inception, cost, etc., of the recently constructed filtration plant in Peterborough. This paper also appears elsewhere in this issue. Following the reading of the paper, several interesting slides were shown, depicting several steps in the construction of the plant and views of the various units, the working of which was thoroughly explained by Mr. Dobbin. The paper gives a general idea of the working of this very interesting installation.

Waterproofing of Reservoirs

The discussion following Mr. Dobbin's paper resolved itself largely to the relating of several experiences in the waterproofing of concrete reservoirs, by several of the members. Mr. R. O. Wynne-Roberts, of Toronto, related an interesting experience in waterproofing concrete reservoirs in Regina, carried out by him some time ago. In this instance, a carefully selected bitumen was used and the entire internal surface of he reservior was swabbed with this material, it being first determined that the taste of the water would not be affected in the least by contract with the bitumen.

The question of the selection of a meeting place for the 1923 meeting of the Canadian section then came up for discussion. The chairman, in introducing the matter stated that several cities had made application for the 1923 meeting, but as it was thought likely next year's annual convention of the parent body would be held in Detroit, and as this convention immediately follows the meeting of the Canadian section, he favored the application of Windsor. After brief discussion, a motion to hold the 1923 meeting in Windsor was carried. The chairman, however, proposed an amendment to this motion to the effect that should the general meeting of the parent body not be held in Detroit as anticipated, the selection of a meeting place for the Canadian section next year be left in the hands of the executive. The amendment also was passed by the members. This brought to a close the first session of the meeting.

The members enjoyed a delightful banquet at the Brantford Golf & Country Club in the evening, as guests of the association. Special cars carried the members to the club house which is beautifully situated on a high site overlooking the Grand River. The speechmaking following the dinner was brief. Besides the chairman, Mr. F. A. Dallyn, Mayor Parker, of Brantford, and Mr. Bunnell, city treasurer, spoke. The latter gentleman reviewed the history of Brantford's water system, from its inception by private interests several years ago to its present state of up-to-date development. He gave much credit for the city's excellent system to those big hearted, public spirited men who were responsible for the first plant and who, in their agreement with the city, allowed for the taking over of the plant by the city at the city's own pleasure and at the actual cost of construction. Mr. F. A. Dallyn expressed the appreciation of the entire body to the civic authorities of Brantford, the chamber of commerce, etc., for the cordiality of their reception.

Standardization of Couplings

The second and final session of the meeting opened on Saturday morning with the reading of a paper on "The Standardization of Hose Couplings," by Mr. N. R. Wilson, chief engineer of the Brantford Water Works, which is published in its entirety elsewhere in this issue.

An interesting discussion followed the raeding of this paper in which many of the members participated. Mr. Dallyn was heartily in accord with the suggestion contained in Mr. Wilson's paper and was the seconder of a motion moved by Mr. Randall that the association go on record as approving the provision of adapters by municipalities made to conform to the hose connections of adjoining towns, which motion met with universal approval. Another motion passed by the meeting in this connection was that the expression of the association on this matter be communicated to the Canadian Engineering Standards association and the Standards Committee of the American Water Works Association. Mr. Wilson saw difficulty in arriving at a standardization of hydrant lengths, owing to the fact that this length must reach below the frost line which varies largely in Canadian cities.

Col. Leisen spoke briefly to the delegates on the importance of holding membership in the A. W. W. A., pointing out the many advantages to be derived from this connection and the valuable information on water works engineering to be obtained from the official organ of the association.

An interesting paper on the "DeLavaud Process of Manufacturing Cast Iron Pipe" was then read by Prof. Gillespie, of Toronto. The subject was thoroughly covered by the speaker, the process of manufacture being illustrated by moving pictures taken at the plant of the National Iron Corporation in Toronto,—the sole manufacturers of pipe under this process in Canada,—and explained in detail by him.

Several micrographic illustrations were also shown of the character of the interior and exterior of the machine-made and old type sand cast pipe, indicating the superiority of the former, also charts of the load tests on the two types of pipe. An invitation was extended by the National Iron Corporation, through the chairman, to all the members to visit the company's plant in Toronto and personally inspect the entire process of manufacture. Mr. F. W. Hudson, of the National Iron Corporation was present at the meeting and answered several questions in connection with the pipe and its manufacture.

The final paper of the meeting was read by Mr. Gore, of Gore, Nasmith & Storrie, consulting engineers of Toronto, on "The Treatment of Hard, Impure Water with Alum." This paper is also reprinted elsewhere in this issue.

Exhibition of Equipment

A new feature in connection with the annual meeting of the Canadian Section this year was a display of machinery, equipment, fittings, etc., of interest to water works men, held in the Palm Room, just off the meeting room. This was the first time that such a feature has been introduced at this gathering and it was a pronounced sucess, upwards of twenty manufacturers being represented. The materials were attractively displayed and representatives of the various companies were on hand during the entire meeting to supply the members with such information as they desired.

List of Exhibitors

Crane Limited, of Montreal, showed their line of brass gate valves, iron body valves, fittings, check valves, piping, etc.

The exhibit of the Canadian Des Moines Steel Co., of Chatham, Ont., consisted of a number of large photographs of their line of elevated storage tanks.

The Thomson Meter Co., of Brooklyn, N. Y., showed their Lambert water meter.

The Horton Steel Works, Limited, of Bridgeburg, Ont., also had an attractive and interesting photographic display of several of their elevated storage tank installations.

The Goldie & McCulloch Co., of Galt, Ont., featured the impeller of their 9-4 B2 four-stage Rees Roturbo pump, with photographs of over 20 Canadian installations, at their booth. A map of Canada was also displayed showing the points, indicated with a red mark, throughout Canada where installations of this company's pump had been made. This map showed installations from Halifax in the east to the Pacific Coast.

The display of the A. H. Winter-Joyner Co., of Toronto and Montreal, was made up of samples of the Bristol line of recording pressure gauges, recording thermometers, etc.

The Hoyt Metal Co., of Toronto, were showing samples of their lines of interest to water works men, which included lead pipe, wire and bar solder, zinc boiler plates, etc.

Canadian Brass Co., of Galt, Ont., also presented an extensive line of valves, fittings, etc., in brass.

Wallace & Tiernan, of Toronto, featured their W & T chlorine control apparatus for the measurement, control and application of chlorine to water.

A most complete showing of valves, fittings, etc., was made by the James Morrison Brass Mfg. Co., of Toronto.

The well known line of valves, fittings and water works supplies manufactured by T. McAvity & Sons, St. John, N. B., were attractively displayed in a prominent location.

The Dominion Steel Products Co., of Brantford, Ont., showed their well known line of "Darling" valves, etc.

The Canadian Austin Machinery Co., of Woodstock, Ont., in addition to their display of several interesting photographs of their extensive line of contracting machinery, in the Palm Room, showed a film, at the Saturday morning session, of several of their ditching, backfilling and other machinery in operation on large contracts throughout this country and United States. Mr. A. S. Robertson, representing the company, explained the working of the machinery during the showing of the film and was also in charge of the company's exhibit in the Palm Room.

The National Iron Corporation's exhibit consisted largely of several various-sized samples of their DeLavaud centrifugally cast iron pipe.

The "Trident" line of disc water meters was displayed at the booth of the manufacturers, the Neptune Meter Company, Limited, of Toronto.

The Page-Hersey Tubes, Ltd., of Toronto, had several samples of their P & H line of bell and spigot steel pipe on display.

The Mueller Mfg. Company, of Sarnia, Ont., showed an extensive line of water works equipment, featuring their reducing and regulating valves and strainers.

Another company with an extensive line of plumbers supplies, globe and gate valves, etc., on display, was the Empire Manufacturing Co., of London, Ont.

The extensive line of brass valves manufactured by the well known firm of Jenkins Bros. Ltd., of Montreal, was well represented at their display.

The Garlock Packing Company, of Hamilton, featured packing for pumps at their exhibit.

Following the showing of the Canadian Austin Machinery Company's film, the retiring chairman, Mr. Harris, and Messrs. Dallyn and Dobbin spoke briefly in appreciation of the co-operation which the Brantford Chamber of Commerce had given them in placing the meeting room at their disposal and for the assistance tendered by their staff of office employees, Mr. Dallyn felt sure the success which had attended this meeting was due in no small measure to this co-operation and the secretary was instructed to convey the thanks of the association to the Chamber of Commerce.

It was the unanimous opinion of the officers and members that this had been the most successful meeting from every point of view that the association had ever held, and Mr. Harris thanked the manufacturers who had brought their goods to display, the members in general and everybody who had helped to make it so.

Water Supply and Sewage Disposal in the Border Cities

The Work of the Essex Border Utilities Commission in Providing a Co-ordinated Scheme for Eight Municipalities—Difficulties in Purification

By L. CLARK KEITH
Chief Engineer, Essex Border Utilities Commission

Before the Canadian Section of the American Water Works Association

A peculiar situation, without parallel in Canada exists along the Canadian side of the Detroit River in Essex County. Eight municipalities with adjoining boundaries front on the river over a distance of approximately ten miles, each with its own municipal government, but all on the same drainage basin and each vitally concerned in its sanitation in relation to its upstream neighbor. There are no outstanding typographical features in any portion of the district, it is universally flat, the difference between extreme contours being about twenty-five feet. With this condition existing, the problem of drainage is an acute one inasmuch as it all must have its outlet in the Detroit River which is the source of the district's water supply.

In the final report of the International Joint Commission in 1918 a board of advisory engineers from United States and Canada, among whom was the provincial sanitary engineer of Ontario, made a resume of testimony which was submitted to them which has a direct bearing on this subject and from which some excerpts are given. "In waterways where some pollution is inevitable and where the ratio of the volume of water to the volume of sewage is so large that no local nuisance can result, it is our judgment that the method of sewage disposal by dilution represents a natural resource and that the utilization of this resource is justifiable for economic reasons provided that an unreasonable burden or responsibility is not placed upon any wated purification plant and that no menace to the public health is occasioned thereby."

Much discussion centered on what was implied in the phrase "burden or responsibility" and the advisory board stated that the safe loading of a purification plant was exceeded if the average number of B. Coli exceeded 500 per 100 cubic centimeters or if in 1/10 c.c. B. Coli is found 50% of the time.

In view of the progress which is being made at the present time in sanitary science, this limit or standard should be regarded as tentative. This is probably a very conservative limit as a filter plant has been constructed on the island of Bob-lo almost at the mouth of the Detroit River, and from which excellent results are being obtained.

It was further stated that "in general, protection of public water supplies is more economically secured by water purification at the intake than by sewage purification at the sewage outlet, but that under some conditions, both water purification and sewage treatment may be necessary." There will probably be general acceptance of the latter finding as a temporary interruption in sewage treatment or contamination from an obscure source or a single individual might at any time endanger the health of an entire community if entire reliance is placed on sewage treatment alone.

Relation of Sewage Disposal and Water Supply

Sewage disposal may bear a varying relation to water supply in their relative treatment: (1) A filtered water supply in conjunction with sewage disposal in accord with the more approved present day methods; (2) the water supply unfiltered but with effective sewage treatment; (3) the water supply unfiltered with sewage treatment which will prevent nuisances and protect fish life. The absolute merits of any remedial measures must in almost every case be considered from the economical aspect as well; a compromise between the two may generally be effected and be acceptable. In Great Britain and Germany practically all surface waters are filtered and if this principle were adopted in Ontario, then sewage treatment to the extent of removing nuisances might be considered effective.

The most serious pollution of any of the boundary waters is found in the Detroit and Niagara rivers. This pollution has its origin chiefly in the sewage and storm flows from the riparian cities and towns and the sewage from vessels. Extensive analysis were made by the International Joint Commission in 1913 and the B. Coli count varied from 5 per 100 c.c. at the head of the Detroit River to 10,592 per 100 c.c. at Amherstburg. In 1920 a further series of analysis were made by the Provincial Board of Health as a guide to a board of engineers reporting on a water supply for the Essex Border District and there was an average increase in pollution of 50% in that interval notwithstanding extensive improvements in the sewage systems of the District.

United Action by Border Cities

The Border Municipalities realizing that independent action in regard to their sewage problem as affecting their water supplies would be fruitless of concrete results, co-ordinated their activities by the formation of the Essex Border Utilities Commission in 1916. The town of Ford, upstream from Walkerville, was without any adequate system of sewers and approval of piecemeal construction was withheld by the Provincial Board of Health. This condition could not be prolonged indefinitely, and in 1917 an extensive report was made to the Essex Border Utilities Commission by Morris Knowles, Esq., dealing with the related questions of sewage disposal and water supply. It was recommended. (1) that an intercepting sewer be constructed from Pelette Road in Ford City along Sandwich Street through Ford City and Walkerville to an outlet in the Parent Avenue sewer in Windsor, (2) that an intercepting sewer be constructed from 14th., street in Ojibway following Main Street, Sandwich Street and Russell Street with its outlet at Park Street in Sandwich.

These two questions were submitted to the ratepayers of Ford, Walkerville, Windsor, Sandwich, Sandwich West and Ojibway and their construction was favored by a vote of 7 to 1. The cost was apportioned among them, taking into consideration area, population, assessment and "capacity times distance" as bases. As an economic factor the interceptors were designed for sanitary flow only with storm overflows into the river. These overflows are regulated by means of positive action floats and sliding gates to admit to the interceptors at all times an amount equivalent to the dry weather flow of the district. Owing to the small available slope it was necessary to construct a sewage pumping station at Walkerville which would lift the sewage from these two municipalities about 18 ft. to a sewer continuing along Sandwich Street to the Parent Avenue outlet. The operating cost of this station is borne by these two municipalities in direct proportion to the amount of sewage they contribute to it, records being available through venturi meters at their boundaries. The Eastern section together with the Walkerville Pumping Station was completed in February 1920. The Southern section was completed in May 1921, and as a result five miles of the river front were freed from sewage pollution, nine objectionable sewage outlets were eliminated and all the sewage from the towns of Ford and Walkerville enters the river below the intakes of the Walkerville Water Company and the city of Windsor. The quantity of sewage so diverted amounts to about 2¼ million gallons per day or is equivalent annually to the total flow of the Detroit River for ten minutes. Eventually the sewer will be constructed across Windsor to a disposal plant in Sandwich. When the International Joint Commission issues the ultimatum that the pollution of boundary waters must cease, the Essex Border District will have the work well under way.

Water Supply

While the construction of these sewers was in progress, there was a periodic demand for filtration due to seasonal disturbances in the water supply. Within the past five years plans for filtration plants have been prepared for both the Walkerville Water Company and the Windsor Water Commission. Neither of these water organizations had taken any action as there was at the same time a feeling in the district that a joint plant might be constructed which would effect economies for all concerned.

Reports on joint schemes were submitted in 1917 and 1919, but they did not offer a satisfactory solution to all interested parties. In 1920 a joint board consisting of F. W. Thorold, representing the town of Walkerville, E. M. Proctor the city of Windsor and Morris Knowles the Essex Border Utilities Commission brought in an unanimous report which they recommended from the viewpoint of economy and of the future growth of the district.

Joint Scheme Recommended

The recommendations in brief were that an intake, low lift pumping station and filtration plant be constructed at Strabane Avenue in Ford City, and that filtered water be supplied through a gravity main to the pumps of the Walkerville Water Company and the Windsor Waterworks. These pumping stations would distribute water as they are now doing for the next thirty years when an existing water franchise expires or until analgamation of the Border Cities became an accomplished fact. As a result of a recent conference the question of the construction of this plant will be submitted to the electors in December next.

Notwithstanding the elimination of the sewage from the river from above the present intakes in Windsor and Walkerville, there is a growing increase in pollution. At the outlet of the Parent Avenue sewer there was an average bacterial count of 10,650 B. Coli per 100 c.c. in 1920, a figure which could only be obtained much lower down the river in 1913. This same condition is no doubt apparent, not only in boundary but inland waters as well, and the one safeguard for the health of this province would appear to be in strict provincial or international control resulting in adequate treatment both of water supply and its complement domestic wastes.

Mr. Stanley Moss, president of the Fidelity Agency of Canada, Ltd., announces that the Fidelity Insurance Company of Canada has been licensed by the Dominion government to carry on the business of guarantee insurance. Mr. Moss who has specialized in underwriting bonds for contractors for over fifteen years predicts a bright future for the new Canadian company which is under the management of Mr. A. E. Kirkpatrick and Mr. Sidney W. Band. The Fidelity Agency of Canada will be special Toronto representatives of the new company.

May 27, 1922

The Work of the Provincial Board of Health of Ontario

What the Board is Doing to Protect the Various Water Works Throughout the Province From Sewage Contamination—Research Activities

By F. A. DALLYN, C.E. (Tor.)
Provincial Sanitary Engineer of Ontario

Before the Canadian Section of the American Water Works Association

Speaking generally there seems to be some misapprehension as to the function of the Provincial Board of Health with reference to the protection of the various waterworks throughout the province from sewage contamination. It has been wrongly assumed by many that it is the duty of the Provincial Board to undertake the correction of conditions, the redress of which lies within the power of the local authorities. It is true that there are certain general clauses in the Public Health Act which empower the Provincial Board to supervise such matters; at the same time there are, also, other clauses prohibiting the pollution of streams, the enforcement of which lies within the power of any individual or any municipality caring to prosecute the matter. So that in the legislation, opportunity is afforded for individuals other than the Board to take action.

When one stops to realize the size of this province, the scattered nature of the urban developments and the small government appropriations which are available in any one department, it is not to be wondered that the Provincial Board is loath to assume the task of minding the business of the municipalities. The task of the Board must necessarily be that of supervision. The exercise of this latter function has brought some splendid results during the past ten years. In 1910 the typhoid death rate in cities was 50.3 for 100,000, and in 1918 it had been reduced to 4.3. In 1920 it was 5.5. This reduction has been gradual.

Reduction of the Typhoid Rate

While the board has always been active in controlling typhoid outbreaks, the first systematic effort to control provincial rates seems to have arisen simultaneously with the work reported upon in the progress report of the International Joint Commission on the pollution of boundary waters. The statistics which were prepared in connection with that report,—which by the way the Provincial Board had a large share in—definitely showed that certain cities along our Great Lakes exhibited typhoid rates very much in excess of the provincial average. Investigations that were undertaken in connection with the water supplies showed clearly that the supplies were in an unsatisfactory condition. The Board in coping with the local situations on this side of the boundary took advantage of the fact that chlorination of water supplies was being advertised as a cure-all and every municipality showing a rate higher than the provincial average was persuaded, or forced if necessary to install chlorination apparatus, which was supervised for a period.

The results of these experiments demonstrated to the Board's satisfaction that certain of these cities on the Great Lakes had been and were acting as distributing points for typhoid fever. The improvement of the local situations, accompanying the administration of chlorine to the water supply, not only had an effect on the municipalities directly concerned, but the effect was also felt all over the province.

That this should be so, may readily be conceded, because of the fact that even though certain situations are potentially dangerous, they will not yield typhoid fever until the organism is introduced from the discharges of people suffering from, or carrying the disease. If the number of cases of the disease are diminished in the province, naturally there is a falling off in the number of coincidences whereby pollution might be introduced for water supplies not so protected.

The typhoid that we have now remaining with us seems to be more or less confined to the smaller towns and to arise from wells and the occasional contamination of the milk supplies. Many of the persons recovering from typhoid fever continue to harbour the organism in the body waste, for a number of years after recovery from the attack.

It is possible, then, to conceive of towns in which the prevalence of disease at one time or another has given rise to a considerable number of carriers, who in turn pollute the wells. There is a remarkable freedom, I am glad to say, from typhoid fever in towns which rely solely upon the municipal water supply.

The supervisory function, therefore, of the Board is mainly concerned in detecting and correcting conditions in centres, which show rates that are unduly high. The Board is fortunate in that Department of the Registrar-General is co-ordinated with that of the Board of Health.

The Duty of the Board of Health

Returning again to the question of just what is the duty of the Board, granting it had all the money that would be required, there arises the question, to what extent will the citizens tolerate the exercise of arbitrary power in matters upon which their information is lacking? What I mean to say is:—Supposing the Board, vested as it is with extraordinary power, should proceed to exercise this power considerably in advance of local information and local education, which is possibly another matter. The result would be—and it can be perceived every year when the House meets,—that there is definite resentment of the authority vested in the Board. If this resentment was province-wide, instead of being confined to a few municipalities or a few individuals touched by the Board's activities, I have no hesitation in saying that there would be an effort, and possibly a successful one, to radically modify the Health Act and to take from the Board the authority, which has made possible the progress noted during the last 10 years.

It must, therefore, be accepted that despite the authority vested in the Board, the exercise of that authority is limited because laws may be amended almost as readily as they are enacted. It has been found necessary where the Board wishes to impose arbitrary judgment upon a municipality to not only inform itself of the facts, but in addition to give considerable publicity to the matter, in order that the citizens should have an opportunity of digesting the Board's conclusions and to re-adjust themselves to those conclusions, the evidence supporting which is not always as obvious as when one has an epidemic condition of disease. It must also be recognized that in these educational campaigns the Board is not only dealing with facts, but has to convince the citizens of its interpretation of the facts, and at the same time to persuade them to loosen the strings of their pocketbooks, a matter requiring considerable diplomacy in itself. This latter phase of the matter of the pocketbook opens up a further question and that question is, which work should take precedence and in this connection, I think it is encouraging to note that the municipalities are spending large sums on the improvement of road surfaces, the extension of sidewalks and works of this nature. So it does not seem that a lack of funds is perhaps the paramount difficulty, when one comes to discuss the question of the treatment of water supplies and of sewage disposal.

Sewage Treatment

Over against the question of policy and precedence there is perhaps a more important question, that is, utility. Personally, as between water purification and sewage disposal, I have always been a firm believer in the treatment of sewage for further protection of the waterworks plants. At the same time, I cannot ignore arguments to the effect that sewage treatment as generally carried out and nominally supervised does not afford the protection that the popular mind conceives to be the case. The situation in Ontario is somewhat aggravated by the fact that our rivers and streams are in general fast-flowing and as a result afford but little storage between the point of entrance and the point of withdrawal. This fact changes the whole complexion of the problem of protecting our water supplies. The storage of water, as many of you are aware, has been relied on in the Old World for protection, for a number of years. The work of Sir Alex. Houston, of some 15 years ago amply demonstrated wherein this protection lay, and he was able to show conclusively that the majority of the pathogenic organisms introduced through a water supply rarely lived longer than two weeks under ordinary conditions and that a period of three weeks was almost absolute protection. Such storage as this is not to the writer's knowledge associated with any of the local situations confronting the municipalities in Ontario, so that if reliance is to be placed upon sewage treatment works, the works in themselves must render the effluent innocuous, and that involves intensive purification and sterilization, and no matter how practical these measures may be, there is no question but that they are expensive and that it is hardly within the province of the Provincial Board of Health to force an issue along such lines at this stage.

Without wishing to dodge responsibility, I think, I can fairly say that in no instance has the Provincial Board initiated proceedings against a municipality for sewage treatment, behind which was not an order or ruling of the courts, or an agreement arising out of an action initiated from sources other than the personnel of the Board.

Standards for the Effluent

I presume some will not be satisfied unless I touch for a moment on the question of the standards required for the effluent from a sewage disposal works. That some statement should be made is particularly pertinent in the minds of many, because of the fact that legislation leaves the matter clearly in the hands of the Board to determine.

It is very difficult to supply a satisfactory answer to such inquiries. An answer has been attempted in England, largely determined from the conclusions of the Royal Commission on Sewage Disposal; but the situation in England is radically different from that in Ontario. The streams are smaller; the uses to which the streams are put much more varied, and the intensity of pollution is very much greater in the Old World than in this. And while it may be conceded that some minimum standard might well be voiced by the Department, it appears impossible without hardship to set a standard, which should apply province-wide.

The situation is very complicated, especially in view of the fact that most of our greater water courses are international in character and the pollution found therein, as has been concluded by the International Joint Commission, frequently rises on one side of the boundary to the injury of the health and property of the other. It would be a hardship, indeed, to impose sewage treatment on the Canadian municipalities along, for instance, the Detroit River, without similar restrictions being imposed upon the city of Detroit. Such a situation, also, holds true with reference to the pollution existing in the lower Niagara river, and the city of Buffalo.

For the more inland towns, local situations have largely governed the quality of the effluent demanded. Few of our streams are so small but what they can satisfactorily oxidize effluents, which have been treated by any of the well-known biological processes. It is about bacterial pollution that the Board and riparian owners have chiefly concerned themselves of late.

The Board hesitates to support any active campaign for the chlorination of sewage effluents, for the reason that it is an extremely expensive undertaking and subject to interruptions which nullify very largely the benefits hoped for. The processes, therefore, which combine clarification, oxidation and sterilization are of particular interest to the Board.

Activated Sludge System

It has been asserted that the Board is particularly biased with reference to the merits of the activated sludge system. I take issue with that conclusion. I admit that the Board and its engineers are thoroughly familiar with the process, having experimented with it continuously since 1914, and that they are exceptionally aware of its advantages and limitations. But the Board has carried out intensive experimental work on the various types of distributing filters, both on an experimental scale, and in connection with the numerous institutions operated by the province; and I may say that this information is as complete as that with respect to activated sludge. The Board is also familiar with the Imhoff tanks. At the experimental station we had in operation one of the first Imhoff Tanks on this continent, in 1912, the results from the operation of which are similar to that obtained elsewhere. The engineers department of the Board being, as I hope, thoroughly informed of the various processes of sewage treatment, has been loathe to recommend any particular type, except upon financial grounds or because of some special requirement of a local situation, determined either from the facts or from a court decision.

No One Type of Plant Insisted Upon

Of late the Board has taken the position that the consulting engineer or the municipal engineer in recommending a sewage disposal plant for a municipality shall state the estimated capital cost and also the annual operating charges of the system. Occasionally, the Board has also required that a similar set of figures be computed for another type of plant, when they are not furnished in the original report. If in the judgment of the Board the operating costs of the two systems, including the interest and the annual charges for retirement, are approximately the same, the Board naturally would favor that system which would yield the most satisfactory effluent. This attitude on the part of the Board is, I believe, the correct one and I think many of you will admit that the Board is pre-eminently in a position to determine or advise as to which plant would yield the most satisfactory effluent, taking all factors into consideration.

You may still then again ask yourself the question what is the Provincial Board of Health doing? If the Board has not taken the initiative in the matter of forcing the municipalities to undertake works for sewerage treatment, it has on the other hand assisted materially in simplifying the legislation whereby a municipality suffering a hardship may take action on its own behalf, and the Public Health Act recites clearly the extent to which the Board will assist or can be asked to assist in respect to such actions.

For your convenience I have included in this paper some of the legislation with respect to the rights of the municipalities in the matter of protection of the water supply.

The amendment to Sec. 14, sub-section (h) of the Public Utilities Act, 1920, is of particular interest in that it permits a municipality to exercise police powers over "such area as may be fixed and defined by order of the Provincial Board of Health" in connection with the source of supply for municipal waterworks. This section can be used to prevent bathing if that it is desired. The old regulations limited the area to within three miles of the waterworks intake. The present statute leaves the matter indefinite as I have indicated.

Extracts

Amendment to Sec. 14, sub-section (h) of the Public Utilities Act., states:—

"Every person who washes or cleanses cloth, wool, leather, skin or animals, or places any noisome or offensive thing, or conveys, casts, throws or puts any filth, dirt dead carcase or other noisome or offensive thing, or bathes in any lakes, river, pond, creek, spring, source or fountain which is the source of supply for such waterworks within such area as may be fixed and defined by order of the Provincial Board of Health, or causes, permits or suffers, the water of any sink, sewer or drain to run or be conveyed into the same, or causes any other thing to be done whereby the water therein may be in any way tainted or fouled, shall for every such offence incurs a penalty not erceeding $20 or may be imprisoned, without the option of a fine, for any term not exceeding one month, and the provisions of the Ontario Summary Convictions Act shall apply to a prosecution under this section."

The Consolidated Municipal Act, 1922 section 399, states that by-laws may be passed by the councils of local municipalities, according to the following sub-section.

10. For regulating the construction of cellars, sinks, cesspools, water closets, earth closets, privies and privy vaults; for requiring and regulating the manner of the draining, cleaning and clearing and disposing of the contents of them.

For requiring the use within the municipality or a defined area of it of dry earth closets.

For providing that the cleaning and disposing of the contents of cesspools, water closets, earth closets, privies and privy vaults shall be done exclusively by the corporation.

For such purpose the corporation, its officers and servants shall have all the powers of the local board of health and its officers and servants.

(b) The council may provide for the expense incurred in such work by imposing in the by-law authorizing the work or in a separate by-law a fixed fee or graded fees varying according to the different kinds of premises served, the time involved in service and such other matters as the council may consider applicable and such fees shall be rated and assessed against the lands in respect of which such services are rendered in the collector's roll of the municipality and collected and re-covered in like manner as municipal taxes.

(c) The council may provide that the collection, removal and disposal by the corporation of the contents of earth closets or other sanitary closets throughout the whole municipality, or in defined areas of it shall be done at the expense of the owners or occupants of the land therein, and for that purpose may impose upon such land a special rate according to its assessed value which shall be collected and recovered in like manner as municipal taxes.

13. For requiring and regulating the filling up, draining, cleaning, clearing of any grounds, yards and vacant lots and the altering, relaying or repairing of private drains.

14. For making any other regulation for sewerage or drainage that may be deemed necessary for sanitary purposes.

68. For requiring owners, lessees and occupants of land in the municipality or any defined area of it to close or fill up water closets, privies, privy vaults, wells or cesspools, the continuance of which may, in the opinion of the council or the medical health officer, be dangerous to health.

70. For establishing, protecting, regulating and cleaning public and private wells, reservoirs and other public and private conveniences for the supply of water; for prohibiting the fouling of them, or the wasting of the water, and for procuring an analysis of such water, and providing for the payment of the expense thereof, and for making reasonable charges for the use of public water.

71. For the closing or filling up of public or private wells.

72. For compelling the use within the municipality or any defined area therein, for drinking and domestic purposes, of water supplied from the water-works of the municipality or of a water-works company; and for prohibiting

the use within the municipality or such area of spring or well water for such purposes.

The following sections of the Public Health Act also are of interest:

90. The Provincial Board shall have the general supervision of all springs, wells, ponds, lakes, streams or rivers used as a source for a public water supply with reference to their purity, together with the waters feeding the same and shall examine the same from time to time when the necessity for such examination arises, and inquire what, if any, pollution exists and the causes thereof.

91. (1) No garbage, excreta, manure, vegetable or animal matter or filth shall be discharged into or be deposited in any of the lakes, rivers, streams or other waters in Ontario or on the shores or banks thereof.

(2) The owners and officers of boats and other vessels plying upon any such lake, river, stream or other water shall so dispose of the garbage, excreta, manure, vegitable or animal matter or filth upon such boats or vessels as not to create a nuisance or enter or pollute such lake, river, stream or other water.

(3) Residents of a health resort or summer resort shall so dispose of garbage, excreta, manure, vegetable or animal matter or filth as not to create a nuisance or permit of its gaining entrance to or polluting any such lake, river, stream or other water.

(4) Any person who contravenes any of the provisions of this section shall incur a penalty not exceeding $100.

93. (1) No sewage, drainage, domestic or factory refuse, excremental or other polluting matter of any kind, which, either by itself or in connection with other matter, corrupts or impairs or may corrupt or impair the quality of the water of any source of public water supply for domestic use in any municipality, or which renders or may render such water injurious to health, shall be placed in or discharged into the waters, or placed or deposited upon the ice of any such source of water supply, or be placed or suffered to remain upon the bank or shore of any such source of water supply near the place from which the supply of water for domestic use is obtained, nor within such distance thereof as may be considered unsafe by the Provincial Board, after an examination thereof by a member or officer of the Board.

(2) Every person who contravenes any of the provisions of subsection 1 shall incur a penalty of not more than $100 for each offence, and each week's continuance after notice by the Provincial Board or local board to discontinue the offence shall constitute a separate offence.

Work of the Board of Health

In addition, to the legislation, the Board provides a laboratory service. In addition to the chief laboratory in Toronto, we have now branch laboratories in London, Owen Sound, Peterborough, Kingston, Fort William, North Bay, and Sault Ste. Marie. Besides these, there is, also a laboratory at the experimental station of the Provincial Board in connection with the investigation of sewage and water. This is under the direction of the Sanitary Engineering Division. Any of these laboratories are equipped and prepared to do water analysis and to definitely determine whether a given sample shows an alarming amount of pollution or not. This in itself is a considerable gain, in that it determines whether sanitary surveys are necessary to round up a source of undetected pollution.

As well as a laboratory service, the Board has been conducting sanitary surveys of the municipalities during the past three years and collecting information with respect to the extent to which public utilities such as water-works and sewage are being used; locating premises unconnected to sewers; determining the number of closets and wells, private and otherwise.

Summary of applications for approval of debenture issues in connection with water and sewage.

Year	Total applications	Total estimated cost
1915	286	$4,679,496.74
1916	190	2,010,070.42
1917	186	2,880,534.72
1918	146	1,590,658.39
1919	256	5,508,698.53
1920	262	7,859,659.50
1921	367	7,305,195.09

All of the information contained in the sanitary surveys is of particular interest in that it reveals conditions which may offer some partial explanation of why typhoid continues to exist in some municipalities, despite improved water supplies.

When this work was undertaken some three years ago, I anticipated finding conditions which were not altogether satisfactory, but at the same time, I had no idea that so many premises were unconnected by either water-works or sewage in many of our larger towns.

The correction of the conditions revealed by surveys of this type naturally rests with the municipal authorities and with the local Boards of Health. It does not appear that the function of correcting the conditions shown should devolve upon the Provincial Board of Health, since it must be perfectly obvious that should the Board give its attention to details of this type there would be no opportunity for covering those general fields of endeavor which in no sense fall within the province of the municipalities.

Research Activities

Finally, I shall conclude my argument as to what the Provincial Board is doing to protect the various water-works throughout the province from sewage contamination by stating that the Board has consistently since the establishment of the experimental station carried on research with respect to matters pertinent to the question under discussion.

Research not only makes available a certain amount of the information for the public and the municipalities in general, but it has afforded the engineers of the Board an opportunity of obtaining first-hand information on many problems that they are confronted with. It gives, too, the Board an opportunity to train its men properly. The laboratory is recognized by the University, so that students may proceed to their Masters degree from work carried on at the experimental station during the University year.

At the experimental station we are capable of carrying on experiments with respect to any type of water purification equipment, and also completely equipped to carry on research in many forms of sewage treatment. Not only do we obtain information as to the results from the various methods when they are working satisfactorily, but we obtain as well definite data as to results when the plant is operated badly. In addition, we get some sense of proportion as to what could be reasonably expected of plants of this type, in view of the many factors entering into their design and the conditions under which they must operate. And it is from information gleaned from such sources that the Board's action with respect to a particular situation is determined.

In summing up, I would suggest for your consideration that the Provincial Board is doing all that its present appropriations and the state of public opinion will permit it to in connection with the protection of waterworks from sewage contamination and that the contribution of the government to this matter is roughly divided under the four headings that I have dwelt at some length upon, supervision, legislation, laboratory service and research.

Alterations to Store in Victoria, B. C.

New Premises for F. W. Woolworth Co., Require Extensive Alterations—Entire Reconstruction of Ground Floor to Provide Open Spaces

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

About the largest single item of building work at present in hand in Victoria is the fitting up of a new store for the F. W. Woolworth Co., Ltd., the operators of a very well known chain of stores specializing in cheap merchandise—the 5, 10 and 15 cent stores. This firm has been operating a store in Victoria for several years on Government Street, the capacity of which has been increased from time to time until the limit of practicability was reached. There has also, during the past year, been a pronounced move of the retail center of the town in an up-town direction, many businesses having found it advisable to follow their trade in that direction due to the influence of the Hudson Bay Co's store which was opened for business on Douglas Street during last summer.

The new store of the Woolworth Co. will be located on the northwest corner of View Street and Douglas Street, and to ensure plenty of room for expansion the company purchased the whole of the old building occupying the corner, known as the Vernon Hotel, and also a vacant lot facing on View Street, so that a frontage will be available of one hundred feet or over on each street. The contract for the necessary alterations, and for the new building to be erected on the vacant lot, has been awarded to Messrs. Luney Bros. of Victoria, for a sum in the neighborhood of $60,000.00 and the work is being prosecuted at a rapid rate.

The alterations required on the portion of the old building which is being adapted for occupation by the Woolworth Company itself necessitated some very tricky and careful work, as completely new underpinning had to be installed. The Vernon Hotel was built in 1890 and the building practice of that day is well exemplified in its construction. The main weight of the building was carried on brick dividing walls running transversely through the building at intervals of twenty-five feet or less, with additional girders introduced where necessary to support the upper floors and partitions, and carried by cast iron columns. The front or street walls were carried by sandstone columns with ornamental pilaster faces, with cast iron columns spaced between where necessary, and the only structural steel in the building was used in short lengths to support the face walls over the store windows.

Extensive Alteration Work

The new ideal of store construction requires, of course, large open spaces and the maximum of window space. To obtain these the plans called for entire reconstruction of the ground floor of the south half of the building. A system of box girders supported on structural steel columns has been introduced and when completed this portion of the building will be entirely open, providing an area of 2,500 square feet, with only two or three interior columns. The weight has already been shifted from the old to the new supports without any difficulties or mishaps.

Left: New Woolworth store, Victoria. General view of premises shortly after commencement of work.

Right; Transferring burden from old to new supports. The old sandstone columns still standing but free of weight.

Arrangements Completed for the Meeting of the Canadian Good Roads Association

The arrangements for the ninth annual convention of the Canadian Good Roads Association at Victoria, B. C., from June 12 to 15 inclusive are rapidly nearing completion, and the Hon. Sam J. Latta, Minister of Education in the Saskatchewan government, who is the president of the Association, is now in the East meeting the executive board to put the finishing touch to what those in touch with the organization declare will be one of the biggest and most instructive conventions held by the association. The secretary-treasurer, G. A. McNamee, has already received notifications of the attendance of a very large number of official delegates, not only from the middle west, and the eastern provinces, but also from highway and automobile organizations in the western coast States across the border. Since the formation of the Pacific Highways Association in 1912 there has been the closest affiliation between the province of British Columbia and the states of Oregon, Washington and California, and quite a number of delegates will be present from the Highway Association of Dalles-California, the Oregon State Motor Association, the Tri-State Auto Club, the Washington State Good Roads Association, and other organizations.

Comparative information which is to hand emphasizes the excellence of the opportunity offered by the convention to see the west, for the special summer rates that will be in force on both railways are much lower than any regular convention rate, even for those who are situated in the middle west, and many delegates are taking their ladies with them on the trip. Many of the delegates from over the border will motor to Vancouver over the Columbia River Highway, and will be able to visit the Portals of Peace on the great highway which was recently opened.

A subject that will be of particular interest to the prairie delegates will be that discussed by K. A. Clark, one of the research engineers of the Scientific and Industrial Research Council of Alberta, who will speak on experiments in improving and maintaining prairie roads. He has been conducting a series of experiments to discover a method of getting bitumen absorbed on the clay elements in soils, and in his lecture will demonstrate the actual effects of these experiments. Another interesting topic is that dealing with modern traffic conditions in relation to the highways, and a representative of the National Automobile Chamber of Commerce, New York, will speak on motor trucks, the maximum weight and width, loads, etc., which will be of particular interest to government representatives who are faced with the problem of constructing highways that will stand this heavy traffic. One of the popular lectures during the convention will be that given by H. D. Cuthbert, of the Northwest Pacific Tourist Association, whose address at the Winnipeg convention was much appreciated.

The list of speakers who have accepted invitations to give addresses or papers on matters appertaining to the highways, from all angles is already a lengthy one, among those who will be present being M. A. Lyons, chief engineer of the Provincial Road Board of Manitoba; C. W. Dill, superintendent of highways, province of Saskatchewan; A. W. Campbell, Dominion commissioner of highways; J. D. Robertson, deputy minister of public works, Alberta; A. R. Hirst, state highway engineer of Wisconsin; B. M. Hill, chief highways engineer, province of New Brunswick; J. A. Duchastel, city manager and engineer, Outremont, P.Q.; James Allen, supervisor of state railways, Olympia, Washington; F. L. McPherson, superintendent of public works, Victoria B. C.; W. A. MacLean, deputy minister of highways, Ontario; F. L. Fellowes, city engineer of Vancouver; H. S. Carpenter, deputy minister of highways, Saskatchewan; A. S. McMillian, superintendent of highways, Nova Scotia, and N. D. Darlington, chairman of the California Highways Commission.

The annual general meeting of the Canadian Good Roads Association will be held on the afternoon of the second day of the convention, Tuesday, June 13, when the annual report and financial statement will be presented and the officers and executive board elected. The banquet will take place on the following night at the Empress Hotel, where all the sessions of the convention will be held.

The Canadian Automobile Association will hold their meeting and dinner at the Empress, at noon on Wednesday, June 14 at which, at the invitation of W. G. Robertson, secretary of the association, delegates from all the provincial motor leagues which are in affiliation with the national organization, will be present.

Program

Monday, June 12th.

9.00 a.m.—Registration of delegates and visitors at convention headquarters.

10.00 a.m.—Congress called to order by President, Hon. Sam. J. Latta, Minister of Education, Province of Saskatchewan.

Second Session, 2.30 p.m.

2.30 p.m.—Address by presiding officer: Hon. Sam. J. Latta, President, Canadian Good Roads Association.

Address by Hon. J. H. King, Minister of Public Works Ottawa, Ont.

Address by Hon. S. F. Tolmie.

"Experiments in Improving and Maintaining our Prairie Roads", by Prof. K. A. Clark, University of Alberta. **Discussion** by M. A. Lyons, chief engineer, Good Roads Board, Province of Manitoba.

"Bituminous Treatment of Gravel and Sand Roads," by A. B. Fletcher, state engineer, Sacramento, Calif.

4.30 p.m.—Appointment of Nomination & Resolutions Committee.

8.00 p.m.—Good Roads Theatre Party

Tuesday, June 13th.

Third Session, 10.00 a.m.

10.00 a.m.—Presiding Officer: J. L. Beckwith, Victoria B. C.

Address: A. W. Campbell, commissioner of highways, Dominion Government, Ottawa.

Address: Hon. P. J. Veniot, minister of public works, province of New Brunswick.

"How to Improve Earth, Clay and Sand Roads," by J. D. Robertson, deputy minister of public works, Province of Alberta.

"Gravel Roads," by A. R. Hirst, state highway engineer, Wisconsin. **Discussion** by B. M. Hill, chief engineer, highways department, province of New Brunswick.

Fourth Session, 2.30 p.m.

2.30 p.m.—Presiding Officer. J. A. Duchastel de Montrouge.

Address: Hon. J. L. Perron, Minister of Roads, Province of Quebec.

"Cement Concrete Roads," by James Allen, Supervisor of state highways, Olympia, Washington. **Discussion** by A. E. Foreman, district engineer, Portland Cement Assn. Vancouver, B. C.

"Road Machinery," by F. L. MacPherson, department of public works, Victoria, B. C. **Discussion** by Geo. Hogarth, chief engineer, province of Ontario.

3.30 p.m.—Annual general meeting of the Canadian Good Roads Association: reception of annual report, financial statement, auditor's report, and election of directors and officers for the ensuing year.

"Colonization Roads," by W. F. Fullerton, superintendent of colonization roads, province of Ontario.

8.00 p.m.—Informal reception of delegates at government house, by Hon. W. C. Nichol, lieutenant-governor, province of British Columbia.

Wednesday, June 14th.

Fifth Session, 10.00 a.m.

10.00 a.m.—Presiding Officer: S. R. Henderson, president, Manitoba Good Roads Assn.

Address: Hon. F. C. Biggs, minister of highways, Province of Ontario.

Address Patrick Phillip, public works engineer, Province of British Columbia, Victoria, B. C.

"Asphalt Concrete Pavements," by F. L. Fellows, city engineer, Vancouver, B. C. **Discussion**: R. G. Davidson, Warren Bros., Portland, Oregon.

"The Motor Truck: Maximum Weights, Speed Width, Etc," by Windsor T. White, chairman, Motor Truck Committee, National Automobile Chamber of Commerce, New York City.

12.30 p.m.—Annual meeting of the Canadian Automobile Association.

Sixth Session, 2.30 p.m.

2.30 p.m.—Presiding Offiicer: T. J. Mahoney, past president, Ontario Good Roads Association, Hamilton, Ontario.

"Provincial Highway Legislation Compared," by F. G. Pearson, past president, Nova Scotia Good Roads Assn., Halifax, N. S.

"Foundations," by J. A. Duchastel de Montrouge, manager & city engineer, Outremont, P:Q.

"Surface and Subsoil Drainage," by W. A McLean, deputy minister of highways, Province of Ontario. **Discussion** by A. McGillivray, chairman, Good Roads Board, Province of Manitoba.

5.30 p.m.—Meeting of newly elected Board of Directors of the Canadian Good Roads Association for appointment of Committees, etc.

7.30 p.m.—9th annual dinner and entertainment, at Empress Hotel.

Thursday, June 15th.

Seventh Session, 10.00 a.m.

10.00 a.m.—Presiding Officer F. A. Gillis, president, Nova Scotia Motor League, Halifax, N. S.

Address: J. B. Harkin, commissioner, Canadian National Parks, Department of Interior, Ottawa, Ontario.

Address: J. P. Hartman, Seattle, Washington.

"Bridges and Culverts," by A. S. McMillan, Superintendent of highways, province of Nova Scotia.

"Road Dragging and Maintenance Competitions," by H. S. Carpenter, deputy minister of highways, Province of Saskatchewan.

Eighth Session, 2,30 p.m.

2.30 p.m.—Presiding Officer: H. H. Shaw, chief engineer, Dept. of Public Works, Province of Prince Edward Island.

Paper by Herbert Cuthbert, executive secretary, Pacific Northwest Tourist Ass'n. "Tourist Traffic."

"How to Finance Road Construction, Bonding & Revenue" by N. D. Darlington, chairman, California Highways Commission, Sacramento, Cal. **Discussion** by Wm. Findlay, business manager, "The Globe," Toronto, Ontario.

"Economical Methods of Handling Materials," by Major H. L. Bowlby, Office of Public Roads, Washington, D. C.

"Maintenance," by George Henri, chief engineer, highways department, province of Quebec.

8.15 p.m.—Social evening and dance, Empress Hotel.

Economic Waste Caused by Lack of Uniformity in Building Codes

Investigation Shows That There Is a Wide Variation in the Stress Allowances — Few Codes Provide for the Economic Use of Structural Materials

By R. G. KIMBELL

Architectural and Building Code Bureau, National Lumber Manufacturers Association, Chicago

It is now generally known, as a result of the publicity that has been given to building code provision matters during the part year, that there is a striking lack of uniformity of city building regulations. In view of the fact that the particular divergence that appears most strange is the greatest variation in allowable working stresses for timber, we recommend a study of the data here presented to any and all who take interest in the economical use of lumber in building construction. Since approximately ninety-five per cent of all homes built are either frame buildings or buildings with frame interiors the strength standards which regulate the size of wood supporting members, and which, therefore, have a direct bearing upon the quantity of materials used in these supporting members, deserve the careful consideration of every one interested in building construction.

Investigation shows that four hundred and ten of the fourteen hundred and seventy-eight cities with a population of five thousand or over have a building code, and that only one hundred and seventeen, or twenty-eight per cent, of these four-hundred and ten building codes specify working stresses for structural timber. In other words, practically ninety-two per cent of the cities with a population of five thousand or more fail to provide in any way for the economic use of lumber in buildings. Fifty-six of the one hundred and seventeen codes which contain stress tables have no stress values for dense Douglas Fir and ninety-eight of these codes contain no stress values for sound Douglas Fir. Seventeen of these codes make no provision whatever for dense Southern Yellow Pine and fifty-eight of them make no stress allowance for so-called sound Southern Yellow Pine.

There is a similar disregard for varying quality in the stress allowance for other species, and some species are entirely excluded from consideration. This should not be. There is no good reason why any species should be ignored in any market, for even though there may be no present demand for it, there may come a time, due to changes in domestic marketing conditions when that species will be used, and when that time comes, the architects and engineers and others, who may have occasion to design in wood, should be given a guide in the form of working stresses in the provisions of the building code. Certainly providing for the use of all of the species suitable for structural purposes would be erring upon the side of safety—if it would be erring at all—and it would take care of the needs of all prospective home builders regardless of the material which they proposed to use.

No Uniformity in Stress Allowances

The National Lumber Manufacturers Association recently made a comparison of the stresses which appear in these one hundred and seventeen building codes which revealed some very strange things. For the sake of having some standard of comparisons, the values recommended by the Forest Products Laboratory of the United States Department of Agriculture were taken as a base and in only one code did the stresses correspond with those recommended by that laboratory. While it is true that the stresses in a number of the codes closely approached those recommended by the Forest Products Laboratory, the great majority of the codes specify stresses very much lower. It is hard to account for this. Our guess is that local committees, when engaged in drafting their building regulations, were so confused by the distracting mass of matter that would naturally come to their attention at such a time, that they, in sheer desperation, reached out and grabbed any working stress that happened to pass before their vision.

These values might have been hidden away somewhere in ancient treatises on strength of materials or have been stowed away within the confines of one or several of the "handbooks" which have come to be such an institution in America. On the other hand, the drafters of code may have trustingly copied the specifications from those contained in the code of a neighboring city without questioning the authenticity of those provisions, and their neighbor years before probably proceeded in somewhat similar manner, and so on and so forth until the origin for the timber working stresses become shrouded in the dim and somewhat mythical past.

Wide Variation

The wide variation in the extreme fibre stresses in bending is most striking. The range for one species varies from two hundred and fifty pounds to fifteen hundred pounds per square inch. The range in three other prominent species (ignoring horizontal shear, compression parallel and perpendicular to the grain and considering only extreme fibre stresses in bending) is revealed by the following figures set down at random from existing codes:

Dense Douglas Fir	800 to 1,800 lbs.
Sound Douglas Fir	1,000 to 1,600 lbs.
Hemlock	600 to 1,500 lbs.
Dense Southern Yellow Pine	500 to 1,800 lbs.
Sound Southern Yellow Pine	900 to 1,500 lbs.

These values give some idea of what we are trying to show, but the following more comprehensive tabular summary of stress variations produces at a glance a more detailed picture of the existing situation.

Effect on the Cost of Building

Now, all this would be very interesting, but not especially vital, if the differences cited had no particular effect upon construction costs. But they do have an important effect upon the cost of building

TOTAL NUMBER OF CODES WITH STRESS PROVISIONS FOR WOOD—117.

Bending

Species of Timber	Extreme Fibre Stress			Horizontal shear stress		
	No. with stresses	No. with no stresses	Range	No. with stresses	No. with no stresses	Range
Douglas Fir, dense	61	56	1800- 800	60	57	750-80
Douglas Fir, sound	71	96	1600-1000	18	99	350-85
Hemlock, eastern	68	49	1300- 600	62	55	250-40
Hemlock, western	30	87	1500- 600	32	85	160-40
Oak	96	21	1800- 600	96	21	240-80
Norway Pine	46	71	1250- 700	43	74	150-40
Southern Yellow Pine						
dense	100	17	1800- 500	101	16	400-70
sound	59	58	1500- 900	58	59	350-70
Spruce	85	32	1350- 250	86	31	500-50
Tamarack	9	106	1200- 900	9	108	170-95
White Pine	81	36	1500- 250	77	40	500-40

Compression

Species of Timber	Parallel to grain "short columns"			Perpendicular to grain		
	No. with stresses	No. with no stresses	Range	No. with stresses	No. with no stresses	Range
Douglas Fir, dense	58	59	1600-100	60	57	800-200
Douglas Fir, sound	15	102	1500-100	18	99	400-200
Hemlock, eastern	62	55	1200- 80	70	47	1000-150
Hemlock, western	31	86	1500- 80	26	91	500-150
Oak	99	18	1500-100	99	18	1000-250
Norway Pine	67	50	1000-100	43	74	400-100
Southern Yellow Pine						
dense	98	19	1800-820	102	15	1500-250
sound	57	60	1200-750	62	55	800-170
Spruce	83	34	3000-600	88	29	1000-180
Tamarack	9	108	1000-750	9	108	350-220
White Pine	81	36	1100- 80	80	37	1000-150

NOTE: Dense and sound in the foregoing includes values for No. 1 and No. 2 structural, long leaf, short leaf, etc., respectively.

and it is for this reason that we urge a reform. To illustrate the effect that such stress variations have upon the cost of building, and consequently, upon the development and commercial growth of a community, suppose we follow through a concrete example of what occurs.

Let us assume that we are supporting a forty-pound live-load on timber joists. Let us also assume that the deflection element may be ignored in this particular instance and that the lengths of the supporting members are to be determined by the strength and not by the stiffness of the joists. We will suppose the span length to be eighteen feet. This then, is what happens in two cities (City "A" and City "B"), where City "A" in the provisions of their building code, allows a working stress in bending of 1,600 lbs. per square inch, and where City "B" allows a working stress of only 1,000 lbs. per square inch for the same kind and quality of wood.

The enterprising citizen of City "A", who contemplates home ownership, can use wooden joists two inches wide and ten inches deep (2" x 10") spaced sixteen inches apart. His neighbor in City "B", if he uses the same size joist, must space those joists ten inches apart and use over one-third more material than he would be required to use if he built in City "A", or he may space his joists sixteen inches apart, just as his friend in City "A" did; but if he does that he will have to use joists three inches wide and ten inches deep (3" x 10") or two inches wide and fourteen inches deep (2" x 14"). If the latter he would use 40 per cent more material than was required to support the same load in City "A", and if the former 50 per cent more material would have to be used.

The injustice of such a state of affairs is evident without any further elaboration on our part; but there is one thing more that should be spoken of here, for it is directly linked up with this matter of stresses, viz., the provisions for proper utilization of lumber suitable for use in building. The stresses appearing in our building codes are based upon very inadequate quality specifications, some codes making no pretense to a quality specification except to set down a few indefinite defect restrictions to be administered by the enforcing officer. The enforcing officer must decide if the materials used are suitable, basing his decision on his individual judgment rather than on scientific requirements. He must have some definite standard in the code on which to base his decisions otherwise they will not stand before a court in case of litigation. High grade lumber is penalized by such procedure, and some of the lower grades of lumber, which are entirely suitable for use in building construction, are not allowed; not because these lower grades will not carry the low stresses which predominate in our building codes, but because the quality specifications keep them out. The working stresses of any structural material presuppose definite quality characteristics. The quality characteristics of structural timber vary (it is the nature of the product), but we know what this lumber of varying quality will do. So it seems that the most logical thing for our cities to do is to recognize this variability and provide a range of stress for each species sufficiently broad to do full justice to the best quality of material and at the same time promote the use of lower quality lumber. Stresses properly supported with quality specifications will guarantee this result, a result important not only to the manufacturer of lumber, but to the user as well for it would permit him to use cheaper lumber for certain purposes where it can be just as properly used as the better class of lumber which his city regulations require him to use now. On the other hand, he could use better quality lumber more efficiently than he can under the present system of low stress values.

It frequently happens that the widely known table of stresses recommended by the American Railway Engineering Association is taken bodily and incorporated in a building code without making use of a very important footnote which reads as follows:

"For buildings, and similar structures, in which the timber is protected from the weather and practically free from impact, the unit-stresses may be increased fifty (50) per cent."

This table as it stands contains stress values recommended for the design of bridges and other structures where timber is exposed to the weather, and unless the stresses are increased as provided for in the footnote, the values are entirely out of line for use in building design.

The Treatment of Hard Impure Water With Aluminium Sulphate

By WM. GORE

Of Gore, Nasmith and Storrie, Consulting Engineers, Toronto

Before the Canadian Section of the American Water Works Association

The art of treating water with aluminium sulphate ('alum' for short) for purposes of coagulating the impurities of color, turbidity or micro-organisms in order to condition it previous to filtration or to settlement with or without filtration is essentially experimental. In spite of the many researches that have been carried out into the problem no one can at present determine the necessary amount of alum or the time required for the reactions to take place or the amount of residual alum in the filtrate in any given instance from a mere study of the salient characteristics of the water. This situation arises from the multiplicity of the important factors involved and their interactions among themselves that in practice the problem becomes too unwieldy.

Notwithstanding this, great strides have been made in the study of the problem by various methods including that of abstraction and a number of mile posts have been fixed along the road towards the complete solution of the problem.

In the treatment of drinking water with alum the alkaline bicarbonates of calium and magnesium existing naturally in the water are relied upon to decompose the alum in solution and to form insoluble aluminium hydrate which is the active agent of coagulation; and as these bicarbonates are almost always present in abundance in hard waters there will always be sufficient present to satisfy the chemical requirements of this reaction. This was practically all that the text books on the subject at one time considered to be necessary. But very little practical experience shows this to be by no means the case.

General experience has shown, and it has been confirmed in systematic experiments by Morison, Pirnie and others that increased quantities of bicarbonates in a water demand increased quantities of alum to treat it and, as might be expected, the same applies to increased contamination and turbidities but the law of increase is different in the two cases. In the former the action is often, although not always, such as would be expected if a certain amount of the alum floc went into solution or in some way failed to precipitate and in the latter case the results are so very uncertain because of the uncertainty of the nature of the contamination. As an instance of the difficulty of estimating the effect of a contamination it has been found in laboratory experiments that one part in a hundred million of gelatine dissolved in Lake Ontario water made coagulation exceedingly difficult.

Laboratory Experiments

Some interesting laboratory experiments on the effect on visual precipitation of clay and silica turbidities of various mineral salts when treated with alum have been made by Smith. This visual effect, although somewhat different from the complete process involving filtration, does show that each substance has an effect of its own and demonstrates how difficult must be the problem of predetermining the alum treatment for a natural hard water which contains many mineral matters. It is interesting to note that soda ash which has been used as a corrective for acidity in the alum treatment of very soft waters showed a distinctly inhibitive effect on the clarification of the water by alum. The same applies to the bicarbonate of soda and most sodium compounds infact nearly all substances experimented with had an undesirable influence on final clarification.

Closer studies of precipitation in the light of colloid chemistry have shown that the process goes through various phases as the application of the alum is increased and the experiments of Morison previously referred to are exceptionally interesting in this particular. They showed clearly there is an optimum amount of alum which increases with the alkalinity of the water and in addition that, coincident with the optimum amount of alum, no residual alum was found in the supernatant liquid but was found there at every other concentration. In these experiments the optimum amount of alum runs rather less than half the equivalent alkalinity and it would be interesting to know if this relation is always the same.

The question of the existence of alum in filter effluents has been closely studied. Hannon and Wolman have found the effluents from all treated waters examined gave aluminium reactions. In the case of Lake Ontario water at Toronto it was demonstrated that the residual alum after filtration became an aluminate the exact nature of which has not been determined.

Stein's experiments of the removal of tannic acid color by alum cover a wide range of both acid and alkaline waters and shows with the latter waters that aluminium hydroxide, although actually formed, is inhibited from precipitating by the tannic acid until an equivalent amount has formed and this part of the subject has been worked out with considerable detail and should prove invaluable to filter operators. (Colloidal Chemistry and Water Purification, Journal of American Water Works Association, page 571.)

Principle Underlying Coagulation

Very few of the reactions that follow from the laws of ordinary chemistry take place in their entirety or some of the expected precipitates do not show up in whole or in part. This is particularly noticeable in the weak solutions of chemicals used in the treatment of drinking water, and colloid chemistry treats of this branch of the subject. In the purest of pure water about one in every six hundred thousand of the water molecules appears to be broken up into two fragments, one hydron nucleus constituting one fragment and one hydrogen atom, one oxygen atom and one electron constituting the other fragment. These fragments of the molecules remain in the water in a peculiarly active state in which they are said to be electrically charged, the intrinsic meaning of which, however, is not completely understood. In this state the separate parts into which the molecules are broken up are called 'ions', the hydrogen nucleus ion is described as positive and the remainder of the molecule negative. The electrical explanation given is that a positive ion contains one electron less than is necessary for stability and a negative ion one more electron than is necessary for stability. Thus the one contains an excess of that energy which the other lacks and to the same extent. If a simple acid be added to this pure water the amount of the dissociation increases and if, on the other hand, an alkali be added, the dissociation decreases.

This is the simplest possible abstraction of the principle underlying coagulation. The impurities in the water such as can be removed by coagulation and filtration appear to be ironized. The same applies to some extent to any and every substance dissolved or in suspension in the water. The removable impurities may be, and generally are, considerably larger than the molecular size and consist of groups of molecules which in an ionized condition will remain suspended in water indefinitely by reason of their mutual repulsions and, to some extent, by that form of energy known as Brownian movements, unless some change is made by which the ionization can be neutralized or balanced in some way by the addition of the proper ingredients in which the ionization is of an opposite character. In hard waters the ionization of the impurities is negative to that of aluminium hydrate precipitated from solution as described above and thus coagulation takes place as the neutralization proceeds.

Coagulation and Precipitation

The act of catching the impurities by the alum is the fundamental point of coagulation and must not be confounded with the precipitation which follows it and one must guard against the assumption that the water which visibly flocs the best will produce the best results when filtered. Sometimes this is certainly not the case. Unless the impurity is caught before filtration very little prospect remains of it being caught at all. In laboratory experiments the mixing of the solution of alum with the water can always be carried out quickly but not so in practice where it is quite possible to find the reactions progress far too quickly for the best results. In some very few instances, however, it has been reported that hours, or even days, may elapse before the reactions are complete. Of these the writer has had no experience but at any event in such cases it would probably be desirable to condition the water before treatment with the alum.

The nature of coagulation being closely associated with the hydrogen ion concentration in water it has recently been suggested that a measure of it in water might be used to determine the necessary amount of alum to be employed and otherwise control the whole purification process, and some considerable progress has been made in which Hannan, at Toronto filtration plant, in collaboration with Wolman, has done most important work. Hannan has shown that the precipitation effects do vary with the hydrogen ion concentration but that with Lake Ontario water the alkalinity is too high to reach the optimum, or isolectric point as it is called, with a reasonable amount of alum treatment alone but this point has been reached by the application of mineral acids to the water. This, of course, might not be permissible in practice but the application of carbonic acid, if it can be dissolved in the water, would be more effective and practical. This, however, could easily be applied in the much maligned pressure filters with ease by maintaining an atmosphere of the gas in the filter. The same end can be obtained by reducing the alkalinity of the water by softening and a third method is to drive hydrogen ions into the water by electrolysis. There is in this method of controlling the purification of the water the possibility that the most effective hydrogen ion concentration floats about with the nature of the water.

It is, however, possible that a careful study of a particular water by this method may lead to some correlation regarding it and the alum requirements. In any natural water the variation in the hydrogen ion concentration is almost invariably due more to changes in the carbonic acid content than to anything else as may be noticed by the considerable change in it due to filtration or to the treatment with alum which while reducing the alkalinity increases the carbonic acid.

In the case of Lake Ontario water at Toronto, Howard has found that the most certain index of the amount of contamination in the water and the corresponding alum requirement is the amount of free ammonia present, but no definite scale relationship has been established and seasonal changes appear to have a very considerable effect; but this seasonal effect is probably due to changes in the carbonic acid content. Coagulation with this particular water appears to proceed much more favorably and satisfactorily during the winter months than the summer months but this cannot be attributed entirely to temperature because the analyses of the results separated into those above and below a temperature of 45 degrees F. do not show the same difference that the corresponding comparison between the summer and winter results do show, but the hydrogen ion concentration is less in summer than in winter; i.e. the water is further removed from the isolectric point. Hannan thinks that to be due to increased temperatures but absorption of carbonic acid by micro-organisms may have the more important effect as they are certainly more numerous in summer.

Smith has shown that the treatment of a hard water with alum is greatly simplified by softening the water with lime applied slightly in excess of the amount necessary to produce the minimum hardness and quotes the case of Little Rock, Arkansas, U. S., as a satisfactory example. It also corresponds with experiments known to the speaker on the reduction of color in Otonabee River water. This corresponds with the laboratory experiments of Morison and Pirnie and the hydrogen ion concentration.

Summary of Conclusions

1. A hard water invariably contains an excess of the necessary ingredients for decomposing the alum but a trace of some form of aluminium remains in the water after filtration in the form of an aluminate except at one critical concentration which is frequently far out of reach.

2. Every substance in the water, whether dissolved or suspended, has an effect upon the amount of alum required and generally the higher the amounts of mineral matter and the harder the water the greater will be the need of alum to coagulate the impurities.

3. The necessary amount of alum or the proper treatment before adding the alum can be determined only by experiment.

4. Gelatinous compounds in hard water seriously inhibit coagulation.

5. The time required for the reactions to take place is mostly short approaching the instantaneous and in some cases too short for the best results unless specially rapid means of mixing are adopted. In a few rare cases the reactions extend over a period of hours or days. In such cases special treatment becomes desirable.

6. In Lake Ontario water in the absence of considerable turbidity the free ammonia content is the best index of the contamination and corresponding alum requirements.

7. The study of the hydrogen ion concentration has been suggested as an index of the amount of alum required and some forward steps have been made by this means.

8. If the hydrogen ion concentration of a water is a measure of the condition of that water for treatment with alum then we might expect the amount of free CO_2 to have a most important effect upon the problem.

9. Filtering in pressure filters in an atmosphere of CO_2 might be expected to bring the hydrogen ion concentration up to the isolectric point with ease and certainty.

10. Softening the water with lime has much the same effect.

11. Forcing charged hydrogen ions into the water would temporarily (at least) also have the same effect.

12. When the isolectric point is reached there is little or no residual alum and the application of the alum is most efficient.

13. Filtering water always raises the hydrogen ion concentration but this slowly returns afterwards if left in contact with the air.

Tenders for Dunnville, Ont., Filter Plant

In connection with the filter plant and pumping equipment at Dunnville, Ont., for which the by-law was passed on April 26th, the following tenders were received.

Building Only

Taylor Construction Co.	$ 22,900.00
Canadian Eng. & Const. Co.	23,000.00
Pigott-Healey Construction Co.	24,900.00
Schultz Bros	25,500.00
W. H. Yates Construction Co.	25,777.00
A. C. Stewart & Sons	26,548.00
F. F. Fry Co.	27,976.00
Robert Bennett	33,340.00
Reid & Somers	34,528.00
Somerville & Dilworth	35,790.00

Combined Tenders

Canadian Eng. & Construction Co.	35,900.00
R. L. Smith & Co.	44,508.00

Filter Equipment Only

Roberts Filter Co.	$ 11,779.00
Permutit Co.	13,386.00
International Filter Co.	14,785.00
New York Continental Jewel Filtration Co.	14,891.00
Pittsburgh Filter Co.	15,061.00

Pumps Installed

Arthur S. Leitch	$ 20,285.00
Turbine Equipment Co.	20,950.00
Canadian Fairbanks Morse Co.	20,313.00
Goldie & McCulloch Co.	20,381.00
London Concrete Machinery Co.	21,510.00
Storey Pump & Equipment Co.	22,454.00
Canadian Ingersoll Rand	24,618.00

Pumps Only

Clayton, Neil & Jones	$ 14,135.00
Canadian Allis-Chalmers	14,590.00
S. B. Whinery	14,661.00
Canadian Blower & Forge Co.	15,346.00
Fraser & Chalmers	15,904.00

The awards were as follows: Building and sedimentation basin, the Canadian Engineering and Contracting Co., Hamilton; pumping equipment, Turbine Equipment Co., Toronto; filter equipment, the Roberts Filter Co., Darby, N. J., U. S. A. E. H. Darling, M.E., Hamilton, is the consulting engineer on the work.

The Lee Automatic Dump Body

The Dominion Truck Equipment Co. Ltd., Kitchener, Ont., are handling in Canada the Lee automatic dump bodies for all makes of trucks. Equipment of this nature is new to Canadian contractors, but has many merits that will be immediately recognized as worth while. The Lee body is an end-dump outfit made in single and dual hoppers of 1 to 3 cubic yards capacity. It eliminates wheelbarrow men and shovelers and is an excellent device for use on concrete road work. Contractors who desire more specific information may get from the above company a pamphlet entitled "Road Building and Paving Contractors' Handbook."

Bracing of Lightning Rods

The bracing of aerial terminals is one to which a great deal of care and attention must be given. Nails must not be used as they are soon loosened by strain and vibration from the elements.

In fastening braces to the roof, screws or bolts must be used. When bolts are used on wooden roofs they should be long enough to pass through the roof and be provided with a nut and washer on the inside; when they are screwed up they should be upset with a riveting hammer so as to prevent the nut coming off. Expansion screws may be used on concrete roofs or brick parapets; and should penetrate the concrete or masonry to a depth of at least 2 inches. The whole construction of the brace should be carried out with a view to strength and rigidity, and, when this is done, an aerial terminal will remain upright as long as is necessary.

The Recently Completed Water Filter Plant of Peterborough, Ont.

General Features of the New Works Which Were Completed at a Cost of $325,000—Filters of the Mechanical Gravity Sand Type

By R. L. DOBBIN
Superintendent of Water Works, Peterborough, Ont.

Paper read before the Canadian Section of the American Water Works Association

The Peterboro water works commission is under the direction of the Utilities Commission, which is a municipal body wholly independent of the city council. The source of supply is the Otonabee River which flows through the centre of the city. It drains the Kawartha Lake district which has a large summer pollution. It also forms part of the Trent Canal and has considerable passenger traffic on it during the summer.

In 1915 the Provincial Board of Health ordered the installation of a chlorinating plant and a Wallace & Tiernan liquid chlorinating machine has been in constant use ever since. The water analysis laboratory has been in operation since 1912 and the record of tests shows the constantly increasing pollution of water.

In the fall of 1919 an estimate of the cost of a filtration plant was made, but on account of high prices, construction was deferred for the time being.

The summer of 1920 saw greatly increased pollution and a chlorine dose of 14 lbs. per million gallons failed to sterilize the water and the citizens were advised to continue the practice of boiling all drinking water. Alarmed at the situation, the Utilities Commission determined to submit a by-law to the citizens on January 1st, 1921. During the month of December, 1920, a campaign of education was waged by means of advertisements in the daily newspapers and addresses to various public bodies. The vote on January 1st was, as a result, largely in favor of the by-law. Plans anl specifications were prepared and tenders called for on April 4, 1921. Contracts were let as follows: Filter plant, W. H. Yates Construction Co., Hamilton; filtered water reservoir, Ramsey & Wilde, Sault Ste. Marie, Ont.; low lift pumps, Escher Wyss & Co., Montreal; connecting pipe lines, Water Works Department.

The following table shows the costs of various parts of the plant:

	Est. Cost	Amt. of Contract	Actual Cost
Filter Plant	$198,347.00	$198,387.00	$197,214.01
Reservoir	75,000.00	65,800.00	63,493.58
Low Lift Pumps	12,325.00	9,685.84	9,685.84
Connecting Pipe Lines	40,715.00	31,126.00	23,917.70
Totals	$326,387.00	$304,998.84	$294,311.13
Engineering	$ 23,613.00		$ 12,600.00
Real Estate			8,511.00
General			9,577.87
Total Est. Cost	$350,000.00		
Total Cost of Completed Plant			$325,000.00

Work was started on April 27, 1921, and filtered water was delivered February 21, 1922, and the plant has operated steadily ever since.

The intake consists of two 30" cast iron pipes leading to the suction well, from which two centrifugal pumps deliver the raw water to the sedimentation basins. The water before entering the basin flows over an aerator consisting of a series of steps. This also helps to thoroughly mix the alum solution with raw water. The sedimentation period is three hours, when the plant is delivering 6 millions gallons per day.

Filter Equipment

The Permutit Company, of New York, were the sub-contractors for the filter equipment, which is of the standard mechanical gravity sand type. The filtering material consists of 18" of gravel and 24" of sand. The underdrain system consists of 2" cast iron pipe, perforated with 2 rows of 7/32 in. holes, spaced every 6 in. High velocity wash is used, the filtered water being drawn from a clear well directly below the filters by an electrically driven centrifugal pump and delivered directly to the underdrain system. This pump is started and stopped by push button stations on each control table. The water after passing through the filters is held in the clear well before flowing to the 2,000,000-gallon filtered water reservoir.

In connection with the plant, there is a completely equipped laboratory for making all the necessary chemical and bacterial tests.

Tenders for Crystal Beach Sewage Disposal Plant

The following is a list of tenders received in connection with the sewage disposal plant of Crystal Beach, Ont., for which E. H. Darling, M.E., Hamilton, Ont., is the consulting engineer. The plant is a 350,000 gal. per day activated sludge plant.

H. M. Balfour, Welland, Ont.	$ 56,228.00
F. F. Fry Ltd., Toronto, Ont.	59,578.00
Central Foundation Co.	59,799.00
Louis Sacco	60,500.00
Andrew Fisher, Niagara Falls	61,500.00
Robertson Const. & Eng. Co., Niagara Falls	65,000.00
MacNamara Bros. Sault Ste. Marie	65,947.00
Reid & Somers, Toronto, Ont.	67,414.00
Can. Eng. & Const. Co., Hamilton	79,700.00
Flanagan Co., Fort William	79,990.00

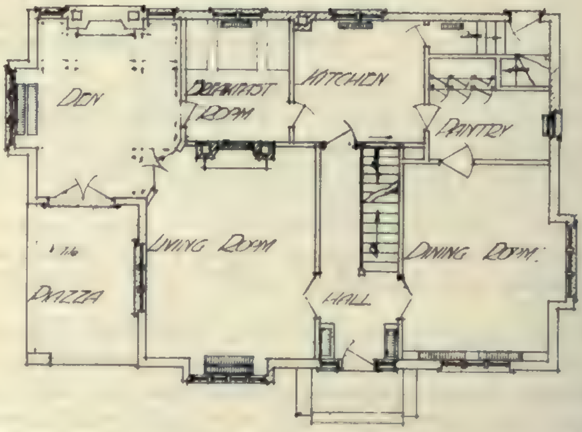
The contract was awarded to F. F. Fry, Ltd., Toronto.

Bucyrus Co. Enlarges Plant

The Bucyrus Company, South Milwaukee, Wisconsin, have under way at the present time, extensive enlargements to both their plants at South Milwaukee, Wis., and Evansville, Ind. These changes and rearrangements are planned to take care of their increasing volume of business and to enable them to manufacture more economically.

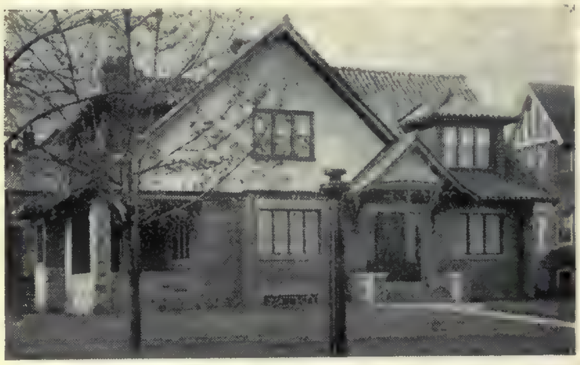
The Contract Record's

Weekly House Suggestion No. 20



The beautiful brick residence illustrated herewith was built on the corner of High Park Boulevard and Sunnyside Ave., Toronto, for Mr. O. H. Moore. The general construction is Milton pressed brick, the gables being faced with stucco on brick. Credit Valley limestone is used profusely in the exterior trim and gives a very attractive finish to the main entrance and piazza. The roofing is of red Ludowici tile, which adds materially to the richness and beauty of the exterior apuearance. There is a large four-car garage at the rear of the house, approached from Sunnyside Avenue, the construction of which is in keeping with the construction of the house and it is tastefully decorated and also finished with red tile roofing.

The interior is beautifully finished, the living room, den, breakfast room and hall being in quarter cut oak. The dining room is pannelled to a height of 6 ft. in mahogany. The den and hall are also pannelled to a height of 4 ft. 6 in., the former having a beamed ceiling. The kitchen and pantry are finished in white enamel and the walls are tiled to a height of 5 ft. The pantry, in addition to the regular equipment, contains a mechanical refrigerator.

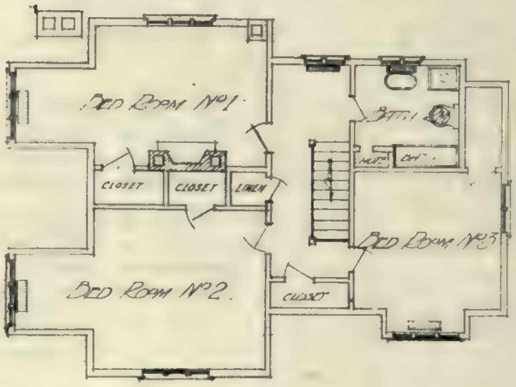


The bedroom flat is finished throughout in white enamel, the bedroom floors being of oak and the bathroom floor of 1-in. hexagon ceramic. The walls of the bathroom are of 3 x 6 tile to a height of 6 ft.

The basement covers the full area of the house and contains a large billiard room, floored with red tile, and a laundry equipped with up-to-date laundry machinery. The house is heated by gas, the plant also being situated in the basement, and there is also equipment here for burning garbage. In addition to the above, there is ample space for coal storage, fruit storage, etc.

The contractors on the house were as follows: heating and plumbing. Messrs. Purdy, Mansell, Ltd.; carpentry, S. R. Hughes & Son; roofing supplied by Roofers Supply Co. and the work carried out by Terry & Campbell; plastering, J. Boyce & Son; electric wiring, J. W. Commeford, and the masonry work, Hawken & Kelley, all of Toronto.

Mr. J. A. Thatcher, of 24 King St. W., Toronto, was the architect who designed this handsome residence.



Fire Fighting Equipment

The American LaFrance Fire Engine Company, Toronto, are distributing a folder describing chemical engines for village fire departments, industrial chemical engines and other fire appliances and protection necessities.

The Montreal Branch Office of the Trussed Concrete Steel Company of Canada, Limited, has been moved from 323 Drummond Building, 511 St. Catherines Street West to 1041-1043 Canada Cement Building, Philips Square, Montreal.

Mainly Constructional

East and West—From Coast to Coast

The Foundation Co. Ltd., of Montreal, have taken new offices at 522 Drummond Building.

According to a recent announcement by Hon. P. J. Veniot, Minister of Public Works, New Brunswick, about $500,000 will be spent on bridge construction throughout the province during the present year.

The Brennan Paving Company, Limited, of Hamilton, Ont., have established a plant at the Galt radial junction, where they will operate, it is anticipated, for some time as they have extensive contracts in this district.

The Ontario Department of Highways has taken over the road from Whitby to Lindsay, as a provincial highway, and work of improving the road will be commenced at once. This improvement will consist of the erection of bridges and culverts and grading to build up bad spots.

A suggestion has been made to the sity council at Brandon, Man., by magistrate A. C. Fraser, that the city purchase a house moving equipment and move 150 residences, at present situated in low lying districts subject to flood conditions, to higher sites in the city which are available.

The city clerk at Windsor has been advised by council to advertise for debenture bids for $1,250,000, for the erection of the following structures: Technical School $666,666; hydro electric system extension, $300,000; municipal housing, $20,000; public schools, $65,738.30: street flusher, $12,000; street lighting, $10,535.76.

The official opening of the new bascule bridge over the Burlington Canal, at Hamilton, took place on May 13, several prominent engineers and public men being present. To the engineer in charge of the erection, Mr. Walter C. Brough, went the honor of christening the bridge. The structure, which was fully described in two articles in the "Contract Record" of Febfuary 8 and 22, this year, is of the Strauss Bascule type and was erected by the Hamilton Bridge Works Company. Mr. J. B. Strauss, of Chicago, the inventor of the design, was a visitor at the ceremony.

At the annual dinner of the Town Planning Institute of Canada, held recently at the Chateau Laurier, Ottawa, the following officers were elected: —Messrs.—J. P. Hynes, Toronto, president; James Ewing, Montreal; Noulan Cauchon, Ottawa, and W. A. Begg, Regina, vice-presidents; Major Douglas H. Nelles, Ottawa, honorary secretary-treasurer, and W. D. Cromarty, Ottawa, librarian. The council elected were: H. L. Seymour, Toronto, H. B. Dunnington-Grubb, Toronto; Prof. Percy E. Nobbs, Montreal; F. G. Todd, Montreal; Lieutenant-Colonel E. T. B. Gilmore, Ottawa; A. A. Dion, Ottawa; Prof. A. A. Stoughton, Winnipeg; L. O. Charlesworth, Edmonton; Prof. E. E. Buck, Vancouver, and W. F. Burdit, St. John, N. B.

Personal

Mr. A. J. Latornell, engineer in charge of the Sewer Section, Department of Works, City of Toronto, has resigned and will be succeeded by Mr. George McCarthy, who has been engineer in charge of the Railways & Bridges Section of the Department of Works.

Mr. Henry Watson has been appointed to take charge of the building department of Messrs. Patten Bros. Ltd., well known firm of realtors and builders, at Windsor, Ont. Mr. Watson has had a wide building experience in Canada, United States and the Old Country.

Mr. Geo. Blanchard, architect, has recently opened an office in the Whalen Building, Port Arthur, Ontario. Mr. Blanchard was formerly with C. D. Howe & Co., consulting engineers, of Port Arthur, for a number of years, and is a member of the Ontario Association of Architects.

Mr. George McCarthy, formerly engineer in charge of the Railways and Bridges Section of the Toronto Department of Works has been appointed engineer in charge of the Sewer Section, which is a larger spending and more important branch than the Railways and Bridges section.

Mr. R. J. Fuller, chief engineer of the John V. Gray Construction Co. Ltd., Queen and River Streets, Toronto, is assuming the managership of that firm's recently opened London, Ont., office which is located in the Bank of Toronto building. Mr. Fuller will continue to be chief engineer.

Mr. Thos. Taylor is succeeding Mr. George McCarthy as engineer in charge of the Railways and Bridges Section of the Department of Works, City of Toronto. Mr. Taylor has been assistant engineer of railways and bridges and has been responsible for much of the important work carried out by that department, including the Bloor St. viaduct.

Messrs. W. H. Martin & Co., contractors and builders, of 28 Harcourt Ave., Toronto, have been incorporated and the name of the firm has been changed to United Building Corporation, Ltd., with a capital of $60,000. Mr. W. H. Martin is president and manager and Mr. Pillsworth, formerly with Pillsworth & Daly, Contractors of Cobourg, Ont., Mr. Charles E. Jex and Mr. Fred Halloway are associated with him in the new organization.

Hon. J. P. B. Casgrain and Hon. J. L. Perron, both of Montreal, were appointed directors of the Canada Cement Company at the annual meeting of that company held recently. The vacancies on the board were occasioned by the resigning of J. C. Cox, of Toronto, and by a change in the corporate by-law increasing the number of directors from fifteen to sixteen.

Obituary

Wm. H. Smith, building contractor, of Toronto, died in that city recently at the age of 61 years. Deceased was born on Scugog Island but had resided in Toronto for the past 40 years.

Mr. Charles Virtue, who for many years carried on a building and contracting business at Toronto, died at St. Michael's hospital in that city recently, after an illness of one month. Deceased was born in Tyrone, Ont., fifty years ago and had lived in Toronto for the past twenty-five years.

Mr. John Henry Shaw, civil engineer and land surveyor of North Bay, Ont., died recently at the age of 56 years. He was widely known in the northern country, having been active in engineering and surveying work in that district for many years, and was municipal engineer for North Bay for three years.

CONSTRUCTIONAL ACTIVITY

Period of May 17 to May 23, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Beauharnois, Que.
Town Council plan construction of sewer. L. Meyer, secy.

Binbrook, Ont.
Jno. E. Peart, Court House, Hamilton, clerk, Wentworth County Council, has plans and will receive tenders until May 30th for construction of 9,500 sq. yds. concrete pavement.

Camden Twp, Ont.
Twp. Council plan drainage repairs. M. S. Blackburn, clerk, Dresden, Ont.

Cumberland Twp, Ont.
W. W. Dunning, Clerk Cumberland Twp. Council, has plans and will receive tenders until June 5th for construction of drains, excavation for bridges, grading approaches for bridges, etc. Plans also with W. H. Magwood, Engr., Cornwall, Ont. Accepted cheque for 50% required.

Fredericton, N. B.
C. S. R. Pennins, City Clerk, will receive tenders until May 30th for construction of watermains on 7 streets for City. Certified cheque for $500 required. G. C. McDowell, Engr.

Fullarton, Ont.
R. H. Pomeroy, Twp. Clerk, has plans and will receive tenders until June 12th for tile drainage work.

Maidstone Twp., Ont.
J. J. Newman, Engr., Davis Block, Windsor, Ont., is preparing plans for pavement for County of Essex. W. P. Coyle, clerk, Sandwich, Ont.

Montreal, Que.
Rene Bauset, City Clerk, will receive tenders until May 30th for construction of a force main crossing over the tail race basin, below present wheel house, for City. Plans at office of the Water Board.

Niagara Falls, Ont.
Tenders will be called shortly for construction of 2" asphalt surface. J. C. Gardner, Engr.

Oshawa, Ont.
Plans are being prepared for approximately 8,500' of pavement, either concrete or asphalt with concrete base, and approximately 2,500 sq. yds. concrete sidewalks. W. C. Smith, Engr.

Saanich, B. C.
By-law will be submitted to ratepayers authorizing an ultimate issue of $750,000 for construction of sewers. Hector Cowper, clerk.

Saanich Council have adopted scheme which provides for improvement of Colquitz Creek at cost of $18,000. Hector Cowper, clerk.

St. Bonaventure, Que.
Town Council contemplate roadwork. Chas. A. Forest, clerk.

St. Flore Est, Que.
Construction of aqueduct is contemplated by Grand Mere City Council. Ls. Berube, clerk.

Stratford, Ont.
A. B. Manson, Engr., has plans and will receive tenders until May 29th for construction of asphalt pavement for City.

Sydney, N. S.
City Council contemplate construction of sewers on Esplanade. R. McKinnon, Engr.

Thornbury, Ont.
Town Council plan construction of waterworks supply system. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Victoria, B. C.
City Council plan construction of pavements on several streets. F. M. Preston, City Engr.

Waterloo,, Ont.
Chas. Moogh, clerk, will receive tenders for construction of pavement. Marked cheque for 5% of tender required.

Woodbridge, Ont.
Council contemplate construction of waterworks supply system. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

CONTRACTS AWARDED

Crystal Beach, Ont.
General contract for sewer and disposal plant costing $57,000 for Council is awarded to F. F. Fry, Ltd., 43 Scott St., Toronto. Contract for concrete pipe is placed with Jno. E. Russell Co. Ltd., Harbor Commrs. Bldg., Toronto. E. H. Darling, Engr., 47 Home Bank Bldg., Hamilton.

Dunnville, Ont.
General contract for sedimentation basin and plant for Town is awarded to Canadian Engineering & Contracting Co. Ltd., 72 James St. N., Hamilton. Contract for pumps is placed with Turbine Equipment Ltd., 73 King W., Toronto, and contract for equipment is awarded to Roberts Filter Co., Darby, N. J., U. S. A. E. H. Darling, Engr., Home Bank Bldg., Hamilton.

Francis, Sask.
General contract for roadwork for R. M. of Francis, No. 127, is awarded to A. P. Wheelock, P.O. Box 334, Regina.

Niagara Falls, Ont.
Bennett & Lovejoy, 95 Dowling Ave., Toronto, have general contract for roadwork costing $29,500 for Queen Victoria Niagara Falls Park Commrs.

Petrolia, Ont.
Contract for steel tank, etc., required for waterworks for Town is awarded to Horton Steel Co., Buffalo and Bridgeburg, at $14,200. Contract for reservoir foundation is placed with Alfred Kilpatrick, Petrolia. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Seaforth, Ont.
Contract for waterworks extension for Town, are: Motor driven pump, Goldie McCullough Co., Bank of Hamilton Bldg., Toronto; gasoline driven pump, Turbine Equipment Co., 73 King W., Toronto; deep well pump, Ontario Wind Engine Co., Liberty St., Toronto. James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Toronto, Ont.
Following contracts have been transferred: Terauley St. from College to St. Joseph Sts., asphalt pavements at $46,318, to the Constructing & Paving Co., Confederation Life Bldg.; Terauley St. from St. Joseph to Bloor Sts., asphalt pavements at $36,786, to the Godson Contracting Co., Manning Chambers.

Contract at $32,283 for construction of sewer on Margueretta St. for City is awarded to A. Cavotti, 257 Euclid Ave. Contract for sewer on Ardagh St. is placed with Grant Contracting Co., 50 Front St. E.

Winnipeg, Man.
General contract for laying underground conduits at cost of $25,064.85 for City is awarded to Carter-Halls-Aldinger Co. Ltd., Union Bank Bldg.

City Council awarded following contracts for construction of watermains: Carter Ave., Dominion St., Boyd Ave., Minto St., Alfred Ave., and Brock St., Fowler, Young & Holden, 505 Electric Rly. Chambers; Ingersoll, Wall and Spruce Sts., Green & Elsasser, 676 Main St.; Minnegaffe St., Thomas Jackson & Sons, 370 Colony St.

Railroads, Bridges and Wharves

Berthier, Que.
Amable Mercier, Secy. Town Council, has plans and will receive tenders until June 8th for construction of concrete bridge.

Caledonia, Ont.
H. Arrell, Caledonia, clerk Haldimand County Council, will receive tenders until June 1st for construction of 2 concrete bridges. Plans with Engrs., Frank Barber & Associates Ltd., 40 Jarvis St., Toronto, and E. Hinchcliffe, Dunnville, Ont.

London, Ont.
Tenders will be received until May 31st for construction of bridge over River Thames for Western University. Plans with Engrs., Jno. M. Moore & Co., London, and Consulting Engr., R. E. Hagarty, Temple Bldg., Toronto.

Public Buildings, Churches and Schools

Aurora, Ont.
A. Love, secy.-treas. High School Bd., will receive tenders until June 6th for erection of addition to school to cost

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Co-ordination of the Building Industry Through a Construction Council

At the present time there is a movement in the United States for the co-ordinating of the whole construction industry through what is called the American Construction Council, on which the organization details are now being completed. The aim of this movement, and of the Council in which the movement finds expression, is by a great effort to raise the standards and efficiency of the construction industry and improve the service which it renders the public. Through the Construction Council will be brought together for conference, for betterment of understanding, and for common action, architects, engineers, contractors, representatives of construction labor, manufacturers of and dealers in equipment and materials, financial, bond and real estate interests, public utility construction departments, and the construction divisions of government and municipal governments—all the elements concerned with building work of any description and with the construction of public works, railroads, bridges, irrigation works and other similar projects.

This action is the culmination of many efforts that have been made in recent years to solve the difficult problems thrown on the industry by reason of its size and complexity and the accumulation of construction due to the cessation of building activities during the war. By means of the new all-embracing organization the various elements of the industry are expected to be co-ordinated in such a way as to be able to grapple effectually with the manifold problems that are involved in the construction business. Until recently each branch of the industry has looked after its own interests, unconscious of its co-operative responsibility to the other elements and very often of the welfare of the public. Through the new scheme, however, the promoters, headed by Mr. Herbert Hoover, hope to improve the service which construction renders the community and the nation as a whole and to produce, under able guidance and leadership, the best of which the industry is capable.

While a large program of work is mapped out for the American Construction Conference, efforts will be concentrated at the start on a few of the more outstanding problems. Chief among these are the following.

The formation of a code of ethics acceptable to the industry and to the public;

The gathering of adequate statistics so that the industry may operate intelligently. While there are partial statistics collected by many sources, they have not been brought together and interpreted in the light of all the facts;

A reduction of the national shortage of building mechanics and the establishment of the necessary apprenticeship system;

A national study of building codes and the working out of a program for carrying the recommendations into effect;

A revision of the existing freight rates on construction materials;

A stabilization of the construction industry to mitigate the evils of seasonal employment and the trade migration of labor.

Other subjects under consideration included, the need for a universal contract form; the National Board for Jurisdictional Awards; National Construction Industrial Board; construction materials forum; estimate guide sheet, standard cost finding system, standard form of financial statements, and equipment rental agreement; apprenticeship, and the shortage of skilled workmen.

The Canadian construction industry is no less in need of such a movement. When considered from the standpoint of the yearly volume and money and labor involved it is the second largest industry in the country. Yet in this mighty industry each element has, with rare exceptions, acted by itself, looking after its own interests, neglectful generally of the rights of the other elements and often indifferent to the rights of the public. During and since the war, construction has fallen off, leaving an enormous deferred volume of construction work. Moreover, the public has lacked confidence in the fairness of building costs and this has added to the pressure put on the industry.

The remedy for these and other allied troubles of the industry lies in its better co-ordination—in the formation of some such body as the American Construction Council which will draw together the multifarious elements of the industry, correlate their efforts and dedicate them to the improvement of the industry's relations with the public. We in Canada will watch with interest the results that will follow this movement in the United States. Any evidence of success will mean that our own industry will be the more willing to adopt a similar plan and thereby pave the way for a higher plane of integrity and efficiency in construction matters.

May 31 1922

Labor Organization in Canada for 1921

The information contained in the Eleventh Annual Report on Labor Organization in Canada, covering the year 1921, which has just been issued by the Department of Labor, shows that trade union membership has suffered a heavy loss during the year. The total membership of all classes of trade unions in Canada at the close of 1921 stood at 313,320, comprised in 2,668 local branches, and indicates losses during the year 1921 of 60,522 in members and of 250 branches. Although a heavy decrease occurred in the following of international organizations, over 71 per cent of trade unionists in Canada belong to this class. There are in all 98 international organizations having one or more local branches in the Dominion, the aggregate for Canada being 2,223, with a combined reported membership of 222,896. These figures show three less international organizations operating in Canada and losses of 232 in branches and 44,351 in members. There are 264 local branches, with a membership of 24,980, of what are termed non-international bodies, a gain of five in branches, but a decrease in members of 926. The number of independent units is 27, three less than in 1920, and the reported membership 15,644, a decrease of 15,545. The national and Catholic unions number 120, four less than reported in the previous year, and the total membership was given at 45,000. The local units of the One Big Union number 34, a decrease of 17, and the membership was understood to be approximately 5,300. The membership of all classes of organized labor in Canada, as reported to the Department for the past eleven years has been as follows:

1911 ..	133,132	1915 ..	143,343	1919 ..	378,047
1912 ..	160,120	1916 ..	160,407	1920 ..	373,842
1913 ..	175,799	1917 ..	204,630	1921 ..	313,320
1914 ..	166,163	1918 ..	248,887		

Trade Union Membership by Provinces

The 2,668 local branch unions of all classes in the Dominion are divided by provinces as follows: Ontario, 1,105; Quebec, 497; British Columbia, 240; Alberta, 216; Saskatchewan, 163; Manitoba, 159; Nova Scotia, 151; New Brunswick, 127; and Prince Edward Island, 10.

There are in Canada 31 cities, a decrease of four, having not less than 20 local branch unions of international and non-international organizations and independent units. The 1,412 branches located in these cities represent 56 per cent of the local branches of the unions above mentioned, and contain approximately 40 per cent of the trade union membership in the Dominion, as reported from the head offices of the central organizations. As in the past, Montreal stands in first place among the cities as to local branches, having 191 of all classes of unions, 101 of which reported 34,637 members; Toronto ranks second with 155 branches, 92 of which reported 32,292 members; Winnipeg stands third with 94 branches, 55 of which reported 7,928 members. Other cities in order of number of branches of all classes are: Vancouver, 77 branches, 47 reporting 7,875 members; Ottawa, 76 branches, 54 reporting 6,377 members; Quebec, 74 branches, 35 reporting 6,128 members; Hamilton, 66 branches, 51 reporting 4,538 members; London, 61 branches, 39 reporting 3,954 members; Edmonton, 60 branches, 35 reporting 3,323 members; Calgary, 60 branches, 43 reporting 3,941 members, St. John, 44 branches, 29 reporting 3,031 members; Victoria, 44 branches, 34 reporting 2,047 members; Saskatoon, 37 branches, 23 reporting 1,215 members; Regina, 33 branches, 26 reporting 963 members; Halifax, 32 branches, 18 reporting 2,125 members; Moose Jaw, 31 branches, 21 reporting 1,633 members; St. Thomas, 30 branches, 23 reporting 1,954 members; Windsor, 30 branches, 21 reporting 1,325 members; Fort William, 28 branches, 18 reportnng 918 members; Sault Ste. Marie, 26 branches 12 reporting 953 members; Brantford, 26 branches, 15 reporting 690 members; Moncton, 23 branches, 13 reporting 2,425 members; Kingston, 23 branches, 15 reporting 756 members; Peterborough, 23 branches, 15 reporting 470 members; Niagara Falls, 22 branches, 15 reporting 1,127 members; St. Catharines, 22 branches, 14 reporting 902 members; Belleville, 22 branches, 16 reporting 1.192 members; Stratford, 21 branches, 15 reporting 1545 memebers; Lethbridge, 20 branches, 17 reporting 1,641 memebers; North Bay, 20 branches, 14 reporting 1,275 members.

Benefits Paid by Central Labor Organizations

Of the 98 international organizations operating in Canada, 75 made payments for benefits, the aggregate disbursements being $24,089,836, an increase of $4,626,226, over the amount expended in 1920. The payments for each class of benefit were as follows:

Death benefits	$ 9,674,060
Unemployed & travelling benefits	423,031
Strike benefits	10.161.987
Sick and accident benefits	3,081,039
Old age pensions & other benefits	749,719

Four of the central non-international organizations made payments on account of benefits, the total being reported at $20,775, of which $16,440 was for death benefits. This is the highest expenditure ever made by the head office of these bodies for benefit purposes..

Benefits Paid by Local Branches

In addition to the expenditures of the central bodies a statement is also published in the report showing the amount paid in benefits for the year 1921 by local branch unions in Canada to their own members. The amount disbursed aggregated $1,503,555, an increase of $1,179,400 over the previous year. The expenditure for each class of benefit was as follows:

Death benefits	$ 197,306
Unemployed benefits	55.557
Strike benefits	1,046.137
Sick benefits	129.211
Other benefits	75,344

Other Features of the Report

In addition to the statistics furnished, the report contains much general information as to the activities of organized labor in Canada as well as to important events in other countries. As a directory of trade unions the report is very complete, containing particulars of every known local trade union in Canada, and also of central organizations and delegate bodies, together with the names and addresses of the chief executive officers for the year 1922.

A chapter in the report is devoted to a class of organized wage-earners who do not belong to the organized labor movement, and include mainly associations of school teachers and government employees. In all there are 41 such bodies having a combined reported membership of 43,298.

Effect of Fire on a Building of Mill Construction in Victoria, B.C.

Deviations from Standard Practice Had the Effect of Counteracting the Fire Resisting Characteristics of Mill Design—Large Continuous Air Spaces

By our Victoria, B.C., correspondent

On the 11th of May, 1922, a serious fire caused a loss of $300,000 which was only partially covered by insurance and completely gutted about two-thirds of the Arcade building, facing on Government, View and Broad streets, Victoria, B. C. This building is a two-storey structure, with stores on the ground floor and offices above. It was built in 1915 and is in the very heart of the retail shopping district of the city.

What makes this building interesting and instructive in view of the fire which has just occurred is that while it is described as being of mill construction, there were certain deviations from the standard practice in that type of construction which apparently resulted in nullifying the fire checking capability of the type completely. And further, the single fire wall which divided the building and which was fitted with automatic doors at the openings, afforded the full theoretical protection to the remaining one third of the building, which has not been injured—except to a small extent by smoke—by a fire which completely destroyed both the building and the stocks of merchandise contained in the portion attacked.

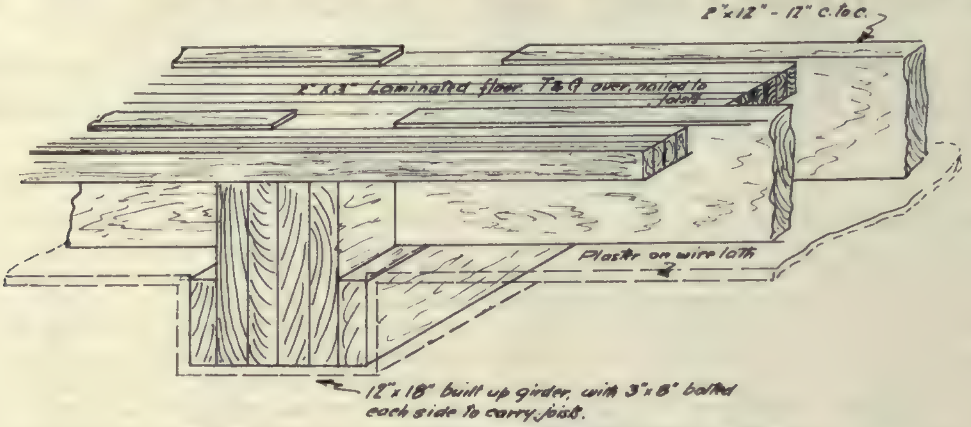
The building code of Victoria contains provisions which establish zones, designating the areas within which buildings of the respective classes A, B, & C may be built. The site of the Arcade building is in the first class area, and consequently called for a building of class "A", which means the best type of modern construction with either steel frame, properly protected from fire, or of reinforced concrete construction. The character of construction is minutely specified in the code which goes into every essential detail. But a section is subsequently appended which states that buildings of mill construction may be allowed in any district, without restriction, and the description given is distinctly vague, while any clauses which could be expected to safeguard the particular features of that type of construction which make it fire resistant, and consequently allowable within the first class fire limits, are conspicuously absent. This omission is apparently due to the fact that it was never contemplated that anything but the best class of construction would be considered for office and store buildings, the mill construction being especially suitable for the class of buildings suggested by the name, viz., industrial and warehouse structures.

Deviations From Standard Mill Construction

The circumstances under which the Arcade building was erected in 1915, however, led to a special dispensation by the city council, allowing certain modifications in the standard mill construction which would give it an appearance more suitable for the uses proposed. The site had been an eyesore for years, due to a previous disastrous fire which had leveled the old buildings to the ground, and being in the heart of the city, with business bad in any case on account of the war, the council was inclined to agree to any reasonable proposition which would have the effect of opening up again for business a site which would otherwise remain a mass of debris. A further consideration was no doubt the employment which would result, there having been very little work for mechanics in the city from the commencement of the war.

The principal structural deviation from what is commonly known as mill construction was in the details of the floor construction which was designed so as to give as nearly as possible a flat ceiling surface in the stores below. An isometric sketch of this detail is given herewith, and shows clearly the probable cause of the spreading and uncontrollable nature of the recent fire. Reference is, of course, to the air spaces between the floor and the wire lath and plaster

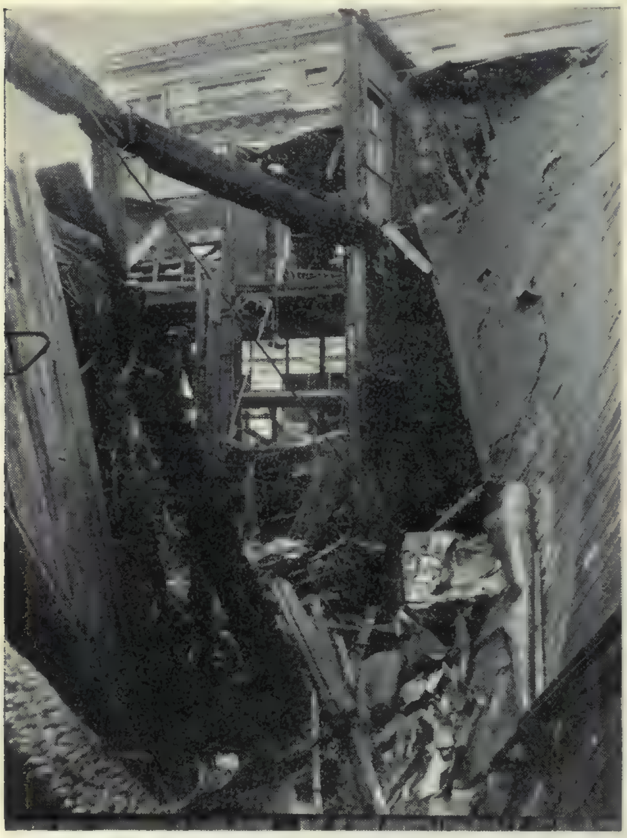
Two views of the Arcade building Victoria, B.C., after its destruction by fire. The fire wall that saved the east end is plainly visible above roof ceiling, which were continuous from girder to girder, in nearly all cases the full width of a store. The lines of girders ran parallel to Government Street, and consequently the stores fronting on that street had girders crossing them at intervals in their length.


2"x12" - 12" c. to c.
2"x3" Laminated floor. T&G over, nailed to joists.
Plaster on wire lath
12"x18" built up girder, with 3"x8" bolted each side to carry joist.

Detail of the floor construction in the Arcade building, Victoria

Large Continuous Air Space

The ceilings on the upper or office floor were suspended from the sloping roof, and were of plaster on Hy-Rib or some similar metal lath. Large continuous air spaces were thus introduced on this floor also, and probably contributed not a little to the complete destruction of the roof which has occurred. The roof itself is of 2 x 3 laminated construction, covered with a prepared roofing and with a light protective coating of cinders laid on roofing pitch. The principal partitions throughout the building are of solid wood, built up of 2 inch x 6 inch laminated. These resisted the fire much better than did the floors and roof, and many are still intact, although out of line on account of the burning away of supports. In some cases partitions have overturned bodily on this account. Posts and girders at the heart of the fire, which started apparently somewhere near the centre of the building, have been completely destroyed and the resultant wreckage is well shown in one of the photographs accompanying.



Looking north through the ruins of the Arcade building Victoria, showing section of roof to the right, fallen in to the ground floor level

The effect of the fire on the floors is very instructive. Built up of 2" x 3" sections, with 3" x 18" joists built in at 12" centres, the fire ate away at the edges, and spread largely by means of the open spaces left between the joists and plaster. But it seems to have been materially assisted by the fact that the lumber used in construction was evidently unseasoned when the building was erected. Shrinkage followed in due course with the result that narrow spaces of perhaps 1/16" to 1/8" existed between each lamination, furnishing additional draft spaces. That this was the case is clearly shown by the state of the wreckage, which reveals definite spaces between the laminations, the inside surfaces of the wood being scorched black and charred to as great an extent as the outer surfaces wherever the flame has touched.

Adherence to Sound Principles of Construction

The obvious inference to be drawn is, of course, that any modifications of the standard type of mill construction which introduce thin sections of timber with air spaces which may become a draft way are inadmissible on sites which require the construction of buildings of the "A" class, with mill construction as an alternative. In other words, mill construction is not the right term for buildings which do not conform to the fundamentals of that class of construction, which depends upon the exposed surfaces of timber to check the fire by their extent and by the absence as far as possible of corners or spaces which may give a hold to the flame. Such a building, in accordance with the approved specifications for construction of this class has been proved over and over again, and experiences with buildings full of modifications of the type, designed for cheapness and the convenience of attaching wood trim and plaster, such as the one destroyed by fire just described, only emphasize the wisdom of adhering strictly to sound principles of construction, especially within first class fire limits.

The Future of the Pacific Great Eastern Railway

An Experiment in Government Ownership That Presents Some Serious Problems—Engineering and Construction Aspects of the Situation

By J. B. HOLDCROFT, A.M.E.I.C.

In view of the investigation which is now in progress by Mr. J. G. Sullivan, M.E.I.C., consulting engineer of Winnipeg, into the major problems of design and location of the Pacific Great Eastern Railway, it is of interest to recapitulate some of the principal figures of the project and to discuss at some length certain features of the design and the conditions which influenced the promotion and subsequent management. Having already absorbed a total of $40,000,000 in round figures, the railway as a provincially owned enterprise is one of the most potent factors in the politics of British Columbia in view of the small population which must shoulder the responsibility, amounting to 523,000 altogether. Repeated efforts have been made to dispose of the road by one means or another, and especially to persuade the Dominion government to incorporate it in the Canadian National system, but so far these efforts have not been crowned with any measure of success, and all indications point to the continued unlikelihood of any change in the ownership of the road, at least during the construction period, and probably until the completed project is in operation and has to some extent justified its existence.

Bonds Guaranteed by the Government

The Pacific Great Eastern Railway Company was at the first an ordinary joint stock railway organization, with no government connection further than the fact that it managed to show such brilliant prospects that the then government was persuaded to guarantee its bonds, with the idea of making them more readily marketable in distant financial centers. This was during the boom years preceding the war and no one was able to see anything in the future other than a continuance of the constantly augmenting stream of business, with prices of land and commodities mounting without check or limit. The breaking of the boom, however, followed quickly by the opening of the war very quickly led to the practical bankruptcy of the railway company, which was in the midst of its construction programme, with the steel laid from Squamish, the present southern terminal to Clinton, a distance of 140 miles, and grading completed or in progress on sections reaching almost as far as the objective, Prince George, on the Grand Truik Pacific Railway. A short section of steel was also laid from North Vancouver, the terminus according to the original plans, to Whytecliff, a distance of 12 miles, with a gap of 28 miles left untouched between that point and Squamish on account of the exceptionally heavy construction costs of the section, which is practically all rock and very much broken up.

Without going into the details of the negotiations which followed, it is sufficient to say that the provincial government found itself bound to take over the road and complete the construction left in an unfinished condition, on account of the obligations it had assumed to the bondholders at the inception of the scheme. In 1916, therefore, steps were taken to undertake this work and protect the investment already incurred, which amounted at that time to about $20,000,000, and in consideration of this action practically the entire property of the company passed over to the government, thus inaugurating what is perhaps the most extensive experiment in government ownership ever embarked upon by a community of half a million people.

Construction Costs Not High

From that time up to the present, about 230 miles of steel have been laid, the road ballasted, bridges built and a regular service maintained to the railhead. This has involved the losses on operation account which are inevitable during the construction period and before the objective of the line has been reached, and the total expenditure, secured by provincial bonds has reached a total, as previously stated, of $40,000,000. Of this sum, owing to the long drawn out construction period, which has covered a space of ten years already, the single item of "interest during construction" has amounted to the staggering total of $9,000,000, so that practically 25% of the total spent is an entirely unremunerative investment, and it seems inevitable that the cost per mile of the road when the gap in steel is spanned and trains are actually running into Prince George will be over $100,000 for the distance of 436 miles. The actual cost of construction for the portion built by the government has amounted to approximately $58,000 per mile after deducting the amounts spent on equipment during the period, and also deducting the interest charges incurred. "Losses on operation" cannot be segregated with the information at hand, and therefore the cost of construction is really lower than the figure given. While, therefore, the cost of construction from the engineering standpoint has not been excessive, the delays occasioned by the difficulties of financing and the unhastened policy of the government have contributed materially to the piling up of a burden of interest which is now amounting to practically $3,000 per day, and which, so far, has been met by loans which, of course, have the effect of compounding the interest.

Opens Up New Country

The scheme as originally conceived by the promoters was an ambitious one. The idea was to connect Vancouver as the principal sea-port with Prince George, the hub of the northern interior, by a railroad which would open up the rich country lying between these points, and which would eventually extend northwards and eastward into the Peace River Block, making connection with the Edmonton—Dunvegan Railway by way of one of several routes which were explored. The route chosen by way of Howe Sound and the valley of the Cheakamus River for the southern end of the line had the attraction of opening up a country which was entirely new, the first 100 miles being mountainous, highly mineralized and containing many magnificent stands of timber. After crossing the divide of the Coast Range of mountains and reaching Lillooet, the first divisional point, country of another type entirely is traversed—what is known as the "dry belt" in which the rainfall is light, and comparatively light timber is found. Country of this kind has been developed into the splendidly productive fruit areas in the Okanagan Valley to the south-east, and a commencement is being made in this section of the country also. Further north a magnificent ranching country exists and there are many immense ranches specializing in beef cattle, while dairying is also coming into its own with the improvement in transportation facilities. Eastward from the present railhead lie the famous Cariboo gold fields, to which a rush is in progress this year, and which have been consistently prospected and worked since the early days of the province.

Economic Consideration Not Sufficiently Recognized

A feature of the original promotion was the townsite at Squamish, which was laid out on a large scale. While this was not intended as the actual terminus, the principal shops of the railroad are located there, and it was confidently predicted that the town has a great industrial future in connection with the development of the minerals and timber of its tributary district. On the strength of this a great deal of property was sold to small investors by a company subsidiary to the railroad which handled all the land concessions and townsites along the route. And it is probably on account of these subsidiary operations conducted by interlocking directorates that economic considerations were not sufficiently recognized in deciding upon such major items of the scheme as general route and termini—at least as far as the south end is concerned. Bearing out this opinion, which is held by many with quite intimate knowledge of the problems involved, is the fact that the town of Squamish, in spite of the lumbering activities in progress in the valley for which it is the sea-port, has progressed very little in actual population since the first days of construction and has a total population after ten years not exceeding 500, many of whom are employees and their families connected with the railroad.

It would seem to be a fundamental of sound development that progress should be from an already established center towards the depository of natural resources, whether the commodity sought is timber, minerals or the product of agriculture. In the present instance, the commodity sought was primarily the business of transportation, if such a term may be permitted in that connection. This is so because a considerable amount of work had already been done towards the development of the actual natural resources of the country to be served—sufficient at any rate to give an inkling of what might be expected. And transportation facilities of a sort already existed, in the form of stages, which in recent years have been operated by fleets of heavy motor trucks handling freight, with large cars taking care of the passenger traffic. The route taken by these cars is the one giving most direct and easy connection with Vancouver, following the old Cariboo trail of the early days to Ashcroft on the North Thompson River, where connection is to be had with either the Canadian Pacific or the Canadian National Railways. This route has been followed from the beginning of transportation into central British Columbia, from the days of the pack-trails onward, and there are many who consider it the logical route for a railway to take in entering that portion of the country.

In Competition With Old Established Route

When, therefore, the Pacific Great Eastern entered the town of Clinton and offered a service for freight and passengers to the coast from that point while construction was proceeding on further sections of the line, it was entering into competition with an old established route served, it is true, only by motor cars, but offering direct entrance to Vancouver after a motor stage of 40 miles to Ashcroft, followed by a 200 mile ride on a comfortable train equipped with sleepers, etc., into the heart of Vancouver, a total travelling time for the trip of eleven hours and arriving at about 8 o'clock in the morning. Against this arrangement the Pacific Great Eastern had to offer a train trip to Squamish taking in all about eighteen hours including a night layover at Lillooet, the divisional point, followed by a steamer trip of 40 miles to Vancouver taking as a rule an additional five hours. These conditions are now improved somewhat, but the steamer is still the only connection with Vancouver, while rapid transit by train into Vancouver itself was under the original scheme dependent on the costly connection between Squamish and North Vancouver and on the construction of a bridge or causeway across the second Narrows of Burrard Inlet, between Vancouver and North Vancouver, a scheme the promotion of which was in the hands of an organization quite distinct from the railway company, and the construction of which has even at this date not been commenced.

The point which is made by the above is, of course, that unless direct train connection could have been obtained with Vancouver from the time a Clinton-to-coast service was offered, the road was bound to be under a heavy disadvantage in competition with the already established route. As a matter of fact, it was common practice after a service was in operation from points further north over the line as constructed by the government, for passengers to alight at Clinton and make the rest of the trip to Vancouver via Ashcroft as described, on account of the saving of time and superior comfort of that trip.

So far I have spoken of the traffic mainly from the passenger's point of view, but the same considerations have in a lesser degree affected the freight hauling business of the road. Heavy freight, of course, has used the road, but a good deal of light freight has continued to go by way of Ashcroft, and those ranchers who have been going into dairying have found it very difficult to get their products to Vancouver in sufficiently short time. The outstanding feature of the freighting potentialities of the line, however, is the fact that, leaving aside the logging business, the great bulk of freight now available and in prospect will originate north of Clinton.

Cost of the System

It seems almost idle to make a comparison of the costs of the two routes. The line from Squamish to Clinton is 140 miles in length, and probably cost an average of $75,000 per mile, excluding the interest charges which have since accumulated. The 28 miles required to link up the two southern sections have been estimated to cost at least $100,000 per mile, while the bridge to connect with Vancouver, which, though it was not being promoted by the railway company was yet an integral part of the scheme, was expected to cost over $2,000,000. Assuming that the railway, for its use of the bridge, might be expected to take care of the capital charges on one-quarter of its cost, the total investment represented by this section of the line would be in the neighborhood of $14,000,000, while a three year construction period, a fair allowance for reasonable rapid progress, would have added perhaps $2,000,000 in interest charges, etc., showing an estimated total for this connection, Vancouver to Clinton, of $16,000,000. Against this, the cost of a line from Ashcroft to Clinton, a distance of forty miles through a comparatively easy country might be assumed at the same rate per mile here given as the approximate cost of the government built portion of the line, viz., $58,000 or a total of $2,320,000 which with interest charges added would approach a final total of $3,000,000. And a further consideration in favor of this route and connection at Ashcroft would be the fact that the line would become practically integral with the already established transcontinental systems and would have the advantage, if desired, of being in a position to make operating agreements which would give it in part the use of the rolling stock of other systems.

Making it Pay

It is simple, of course, to find causes of criticism in almost any design after years have past and events brought out to view the weak points which circumstances of the time probably effectually concealed from those who were responsible for the framing of policies. And with the war behind us and the years of reconstruction struggling on towards a fuller realization of the economic principles which govern business, both big and small. by the same inexorable rules, we now are perhaps in a much better position to exercise a dispassionate judgment on the policies to be followed than were those whose work was done in the heat and rush of the busy boom years preceding the war. And after all, criticism of the past is not constructive except in so far as it points towards the pit-falls to be avoided in making further progress.

In any case, British Columbia is now faced with the problem of what to do with a $40.000,000 investment which is still incomplete, so as to not merely catch up on previous losses incurred but if possible. to make a profit. As previously stated, interest is at present being paid by means of further borrowings and a surplus of income over operating expenses of approximately $2,000,000 would be required to meet the interest charge alone, while a similar amount, depending on the term of the bonds issued. would be needed to cover the sinking fund for payment. I am, of course, aware that the path of least resistance is frequently followed in regard to repayment and bonds retired at maturity by the simple process of floating a new issue. Whether this will be the only course open or it may be possible to make reductions from the funded debt by degrees by means of issues of capital stock, preferably, of course to residents of British Columbia, remains to be seen in the future, but the latter most desirable contingency. hopelessly quixotic as it may seem to-day is by no means so unlikely as it appears, and depends on the evolution at this time of a sound policy of development and business creation for the line.

A study of the situation of the United States railroad system is illuminating in this connection. The figures following are taken from a statement issued in 1909 as reflecting conditions more nearly normal than anything issued since that date. From this it appears that the average cost per mile of all roads in a total of about 240,000 miles $83.000 in round numbers. This represents the entire investment, of course. including rolling stock and all other equipment. Of the total investment of $20,000,000,000 practically 38% was in the form of capital stock and in that year, besides paying the accrued interest on ten billion dollars in bonds the roads paid out dividends on capital stock at a rate of over 4%, or put in another way, $1,337 for every mile of road in operation. The roads at that time were prosperous, under good business management. with a reasonable scale of wages in all departments. and a considerable contrast is offered between the situation described and the wasteful and extravagant management under amateur control by politicians which has driven these same roads near to bankruptcy in recent years.

Remedial Measures

Applying this comparison to the Pacific Great Eastern Railway. it is evident that on the basis of capital investment per mile of road the situation is far from hopeless, the figure for the local road being under the worst construction conditions not over $100,000 per mile including everything. and the problem now is to make the road revenue-producing on a profitable basis with the least possible additional expenditure. From the engineering standpoint, as well as on account of practical consideration of traffic already explained, the first step will very likely be the construction of the forty miles of line from Ashcroft to Clinton, linking up the road with the two transcontinental lines and establishing direct connection with Vancouver. Beyond this, it does not seem likely that any very radical engineering alteration will be recommended, but a definite policy of traffic development will have to be inaugurated. This should take the form of industrial and colonization work with the necessary publicity framed so as to attract the permanent settler, whether agricultural or industrial, rather than those whose interests are mainly speculative.

A comprehensive industrial survey of the whole line and its tributary area should be the basis of this work, and would also result in the location of a system of roads radiating from already old established centers such as Lillooet. Clinton, Williams Lake. Quesnel, etc., so as to gradually open up to motor truck transportation all the best agricultural areas. Mining and lumbering developments will for the most part require branch lines, but can in most cases well afford to build them at their own expense. But it should be recognized that branch line traffic, at least as far as ordinary freight is concerned, will more and more largely be replaced by the motor truck on well surfaced roads, possibly carrying standardized bodies which can be loaded at the point of origin, placed six or eight on a flat car for main line transport and lifted off onto the motor chassis for the final run to the consignees' door.

Management

There is absolutely no doubt as to the potential riches of the belt country which this railway will serve, so that the problem simply becomes one of attracting and maintaining a constantly increasing volume of traffic by progressive methods, without, however, any element of the "boom" of other days, but on sound economic lines based on an accurate knowledge of the country and its resources. This fund of information has yet, very largely, to be compiled, and in its gathering and subsequent profitable use lies an unique opportunity for both the engineering and management sides of the organization to transform what is now a heavy liability into a paying proposition. This is a large programme, and the experience of others who have been faced with similar and greater problems might well be followed. The present directorate of the road is composed entirely of cabinet ministers and the general management is closely held by the directors, headed by the Minister of Railways, the Hon. John Oliver, who is also premier of the province. It is quite probable that an independent directorate of practical railroad men, thoroughly experienced in the field, would if intrusted with the responsibility be able to bring to bear a breadth of knowledge in this particular highly specialized sphere which would result in an earlier and more satisfactory solution of the present difficulties, which almost amount to an impasse, than would be at all possible, with the best of intentions, to men who are already overburdened with the duties of their ministerial offices. This has been done in the case of the Canadian National System and the example is well worth copying if men of sufficient vision can be found for the work in hand.

A warning against increasing construction costs was voiced by leading keneral contractors of the United States at a recent meeting in Washington. They pointed out that if prices of raterial and labor are increased due to the great volume of construction now being started, stagnation and depression are sure to follow, similar to the depression in the construction industry in 1921, which followed the boom of 1920, when prices and wages went skyrocketing. In this connection the National Executive Board of the Associated General Contractors strongly urged that a reasonable stand be taken by all elements of the industry to keep costs at the lowest possiple level if the great construction program needed by the country is to be carried through successfully.

Revised Steel Bridge Specifications

A New Edition of the Standard Specification for Steel Railway Bridges Has Been Issued by the Canadian Engineering Standards Association

A revised edition of the standard specification for steel railway bridges has just been issued by the Canadian Engineering Standards Association. There are a number of changes which increase the usefulness of the specifications. The sections dealing with movable bridges have been withdrawn, as a separate specification for movable bridges is in preparation; a number of clauses have been rearranged, revised, or expanded; and a section has been added regarding erection. The requirements and recommendations as to paint and painting have been stated more fully, and a diagram has been added showing the various standard types of spans. It has been found possible to modify certain clauses so as to bring them into substantial agreement with the corresponding requirements of the American Railroad Engineering Association, as for example in the case of the formula for compressive stress on columns.

The work of revision has been carried out in consultation with the bridge departments of the Canadian National, Canadian Pacific, and Grand Trunk Railways, valuable assistance has also been received from the Chairman and Members of the Sub-Committee on Steel Highway Bridges.

The present edition was approved by the Sub-Committee on Steel Railway Bridges on December 22nd, 1921, and by the Sectional Committee on Steel Bridges and Construction in January, 1922.

Inasmuch as the section on erection is new, its clauses are reprinted herewith as being of interest to bridge designers and builders. The clauses are numbered as they appear in the specification.

210. Unless otherwise specified, the work of erection shall include the furnishing of all necessary tools, erection bolts and equipment, the unloading of the material at the site, and the furnishing and construction of any falsework required. The contractor shall provide for the cost of labor and all other incidental expenses necessary for the erection and completion of the structure.

211. When the erection work is finally completed, the contractor shall remove from the site all falsework, rejected materials, and debris caused by his operations, and leave the site in as clean and tidy a condition as he found it. This work shall be done without any additional cost to the purchaser.

Unloading and Storing

212. Cars containing materials or plant shall be promptly unloaded by the contractor upon delivery, and in case of failure to do so the contractor shall be liable for the railway's regular demurrage charges.

213. All materials shall be handled during unloading with the greatest care possible to prevent injury to any of the members, and also to prevent as far as possible any injury to the paint. Materials shall be stored on skids or blocking placed so as to keep them clear of the ground and of any standing water. All materials shall be stored at such locations as will not interfere with the operation of the railway.

214. The contractor, while unloading material, shall compare and check off each piece with the original shipping list and shall report promptly any shortage discovered.

215. All small bends or twists received by members during transporation shall be rectified before such members are put in place. Any serious bends or damage shall be reported at once to the engineer for instructions.

216. All rivets shall be power driven unless otherwise authorized by the engineer.

217. In driving rivets, the bucker and the hammer

snap shall be placed directly opposite each other and at right angles to the riveted surfaces, and no tilting of snaps will be allowed. Rivet heads shall be well formed, concentric with the shaft of the rivet, and shall hold the several members together tightly.

218. Rivets shall be heated uniformly to a light cherry red and driven while hot. Rivets, when heated and ready for driving, shall be free from slag, scale and carbon deposit. When driven, they shall completely fill the holes. Loose, burned or otherwise defective rivets shall be replaced. In removing rivets, care shall be taken not to injure the adjacent metal and, if necessary, they shall be drilled out. Caulking or re-cupping will not be permitted.

Turned Bolts

219. All turned bolts shall be perfectly tight in to prevent the nuts from becoming loose.

Unfilled Holes

220. No unfilled bolt or rivet holes shall be left in any part of the structure.

Decks

221. Unless otherwise specified, the contractor shall frame and place all timber in the bridge deck.

222. Unless otherwise specified, the purchaser will supply the timber necessary for the deck delivered at the bridge site.

Maintenance of Traffic

223. The contractor shall give all assistance required of him by the railway forces to help get the track connected up ready for traffic after any interruption to same caused in any way by his operations. The cost of this work shall be included in the contractor's tender for framing and placing deck timber, or where there is no timber deck, this cost shall be included in the tender rate for erection of the new structure.

224. The contractor shall not, without the special permission of the engineer, interfere with the operation of the railway.

225. Changes in any structure supporting operating tracks, or changes in the approach tracks, shall be undertaken only under the direct control and supervision of the railway.

Removal of old Structure

226. When an old structure is to be removed, this work shall be done as directed by the engineer.

227. Unless otherwise specified, old timber structures shall be completely dismantled. The timbers and iron work shall be piled separately at some convenient location as directed, or loaded in cars supplied by the purchaser for this purpose.

228. Steel spans shall be removed without dismantling if they can be handled and loaded on cars for shipment. If spans are cut apart, each span shall first be fully match marked, and also marked to show the span number and the mile and subdivision location from which it is being taken. All marking shall be done with white paint. The match marking diagram shall be approved by the engineer before spans are marked and removed.

Anchor Bolts

229. After any span has been erected in place and pier members set, the contractor shall drill all necessary anchor bolt holes in the masonry and set anchor bolts in portland cement grout.

230. In the case of viaducts or other structures where the anchor bolts have been set in open holes in the masonry during construction, the contractor shall fill these holes with portland cement grout after erection of the steel.

231. When erection is carried on during freezing weather, the contractor shall keep all anchor bolt holes free of water.

Cleaning Steel

232. After erection, the steelwork shall be cleaned of all dirt, rust and loose or broken paint.

Painting after Erection

233. All rivet and bolt heads and bare or scratched spots shall be given one coat of the shop paint before the field coats are applied.

234. Unless otherwise specified the entire structure, except metal to be encased in concrete, shall be painted by the contractor with either the one or the two coats which have not been previously applied.

235. Surfaces which are to be protected by concrete casing shall not be painted, and all such surfaces shall be left in a perfectly clean condition, free from all dirt, rust, grease, or paint spots.

236. No painting shall be done in damp or foggy weather or at any time when the temperature of the steelwork is below 40 deg. Fahrenheit. No paint shall be applied to surfaces which are not absolutely dry and clean.

Paint

237. Unless otherwise specified by the engineer, paint shall be supplied by the contractor and shall be in accordance with the Specification for Paint as given in Appendix XI.

Mixing of Paint

238. The paint shall be thoroughly stirred just before applying, and the pigments shall be kept in suspension.

Application

239. The paint shall be of proper working consistency and each coat shall be thoroughly brushed out and allowed to dry completely before the application of the next coat. The paint shall be carefully worked into all joints and open spaces.

240. No paint shall be used unless the containers bear the seal of the Inspector and the contractor has been notified that the paint is satisfactory for use.

Inspection

241. The contractor shall allow the inspector free access to all parts of the work at all times, and will facilitate in every reasonable manner the inspector's duties in ensuring that all work is done in accordance with the plans and specifications.

Erection Inspector's Authority

242. The inspector on erection work is authorized to reject, at any time during the progress of the work, any piece of material or any member which he may find defective in any manner or not in accordance with the detail plans. This material may be rejected notwithstanding any previous acceptance, and any pieces so rejected shall be replaced by the contractor without extra charge.

243. The contractor shall comply with all special or local ordinances or regulations appertaining to the work, and shall protect the purchasers against any claims due to lack of compliance with such ordinances or regulations.

Controlling the Quality of Materials in Highway Construction

Laboratory and Field Methods of Testing Road Materials—Necessity for Inspection—Importance of Control on the Job—Administration of Laboratory Work

By **JOHN H. BATEMAN**
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Before the eighth annual conference on Highway Engineering at the University of Michigan

Highway construction and maintenance are affected by a great many factors all of which are of more or less importance in the successful prosecution of work. Leaving out of consideration administration and financing and considering the items of construction and maintenance, we may quite probably consider two factors which are necessary to attain good results. These two factors are: good workmanship and a good quality of materials. The inspection of construction and maintenance work deals to a very large extent with these two factors and the careful inspection of both is necessary to insure good work. The necessity for this inspection may generally be considered as due to three principal causes: first, an intent on the part of the construction organization or the producers of materials to actually do poor work or furnish low grade materials; second, carelessness on the part of employees, and third, ignorance of the work, due to unfamiliarity or lack of training or experience. The first of these reasons is probably responsible to only a small degree for the necessity of careful inspection of materials. The latter two reasons are probably responsible in a much higher degree for the presence of a poor quality of material on any work. Under inspection of materials we should also include the necessity or desirability of the work of controlling the proper use of these materials.

The control of quality of materials in highway construction and maintenance, as in other forms of construction and maintenance work, is of a two-fold nature involving both laboratory methods of examination and field testing. These two factors are not distinctly separate operations, but are bound together by reason of the nature of the work, and the successful control of materials depends entirely upon the proper relationship existing between laboratory and field inspection forces.

Laboratory methods of examination in many cases are necessary because of the difference in methods of analysis of the many materials entering into the construction and maintenance of highways. In the case of many materials proper examination consists of both laboratory and field work. A brief description of some of the more important tests of various materials may be used to illustrate this relationship.

Laboratory Tests Essential for Portland Cement

We are familiar with the various tests of portland cement which have now been adopted as standard over practically the entire country. These tests must necessarily be conducted under rather strict conditions as to apparatus, temperature and other working conditions and make laboratory examination a necessity. The examination of portland cement involves tests which may be grouped into three classes as far as the element of time is concerned; first, we have these tests which may be completed within a period of twenty-four hours; second, strength tests which may be completed at the end of seven days, and third, strength tests which may be completed at the end of twenty-eight days. Portland cement is usually required to satisfactorily pass all of these tests, but on account of the long time intervening between the beginning and completion of all of the tests, it has usually been the custom to provide for the acceptance of portland cement on the basis of twenty-four hour or seven-day tests, either tentatively or entirely, reserving the right to require in one case seven and twenty-eight day tests, and in the other twenty-eight day tests in the case the cement fails on either seven day or twenty-eight day tests after having passed preliminary tests referred to.

In the examination of sand, gravel, crushed stone and crushed slag, the services of a laboratory may properly be made use of most especially in the examination of preliminary samples. After the quality of these materials has been definitely determined, proper control may well be said to be a duty of the field inspector.

The examination of ledge rock, on account of the character of the tests involved, makes laboratory tests a necessity. The tests ordinarily conducted to determine physical qualities are: hardness, toughness, abrasion and compressive strength. These tests all require more or less expensive and heavy machinery which, for economy, must be located in a rather extensively equipped laboratory. After the quality of a certain product has been determined, further tests are not usually necessary within a period of one year's time of making the initial tests in those portions of the quarry at which operations are being carried out.

Proper inspection of paving brick involves the utilization of machinery which may only be properly installed in a laboratory, either at the plant itself, or in a central laboratory for the examination of such materials.

The quality of asphalt and tar products also involves the utilization of a properly equipped laboratory on account of the exacting methods of analysis required in this industry. The relationship between laboratory and field examination will be touched at a later point in this discussion.

In addition to these materials we have other materials, such as structural and reinforcing steel, corrugated metal pipe, paint and others which represent materials for which laboratory methods of examination are necessary.

Field Control of Materials

As I have stated before, the proper examination of materials involves both laboratory and field methods. Most of us are familiar, at least to a certain extent, with the various methods utilized in the laboratory. Many recent developments, however, in connection with desirable field control of materials are of particular interest and value at this time. It is my purpose to describe some of these various methods in an attempt to point out their value and the relationship which should exist between field and laboratory inspection with various materials.

Field work involves one of the most important of the operations in connection with all testing. I refer to the matter of sampling of materials. It is perfectly evident to all of us that the proper interpretation of results of tests conducted, either in the field or in a laboratory, is necessarily dependent upon the method which has been used in obtaining the sample for examination. It may not be amiss to describe, in connection with various materials, some features of sampling which must be carefully observed in order to insure obtaining test results which are representative of the bulk of the material sampled and tested. In this connection we may refer to three features as the principal factors which must be observed in connection with sampling operations; first, the method of sampling must be such that the sample taken represents as accurately as possible the bulk of material sampled; second, the size of the sample must conform to the quantity of material necessary for conducting tests, plus an extra quantity to retain for reference purposes; and third, the container to be used in transmitting the sample of material from the point of sampling to the laboratory must be of satisfactory kind and size.

Cement Testing

Portland cement is used in very large quantities in both highway construction and maintenance. The necessity for careful sampling is quite evident on account of the method of manufacture and shipment of this material. It is now generally recognized that a sample of portland cement should be taken from every 200 to 250 barrels of material, this quantity being approximately that contained in one carload. Portland cement is shipped in cloth or paper sacks, or in bulk. In taking samples from shipments in sacks, a small amount—let us say about ½ pound—should be taken from each of about twenty sacks selected at random from a carload or an equal amount of cement. It is not necessary to open up the sack of cement to obtain the sample. A small valve is placed in the end of both cloth and paper sacks to be used for filling by means of the automatic sacking machines now generally used in all portland cement plants. A small sampling tube map be inserted through these valve openings and the necessary quantity of cement obtained in this way without disturbing the sack itself. In the case of bulk shipments of cement, the most satisfactory method of sampling is by means of sampling rods with which we may be sure to reach all parts of the material. Cement samples may properly be shipped in closely woven canvas bags. The quantity actually required for testing is approximately five to six pounds, and samples should preferably contain from 8 to 10 pounds of material.

Sand samples should consist of about twenty pounds of material and should be obtained by taking small portions of material from various parts of the supply represented and combined to form a test sample. Samples of gravel and crushed stone should be taken in a similar manner, about 30 or 40 pounds of material constituting a proper size sample. These samples may be transmitted in canvas bags or tight boxes.

Sampling Rock

General experience seems to teach us that a great deal of difficulty is usually obtained in securing representative samples of rock from ledges in quarries. As a first consideration rock should preferably be sampled by taking samples from all the different formations within the quarry. In some quarry examinations the speaker has selected as many as 25 or 30 samples to determine the entire range of the material in a given quarry. Samples of ledge rock should consist of about forty pounds of material larger than 1½ inch in size. At least one piece of material should be approximately 5 x 5 x 4 inches to enable cores to be drilled with a diamond drill for the hardness and toughness test. Owing to the nature of the material these samples should preferably be enclosed in tight boxes rather than shipping them in sacks which usually become destroyed or damaged in shipment.

In the case of paving brick, samples should be taken which accurately represent one lot or shipment of the brick. One sample should be taken to represent the softer brick in each load or shipment, and another sample to represent the hardest brick. In addition, a third sample representing the general average of the material should be selected. Twelve paving bricks should constitute a sample and should be shipped in a box, or crate, preferably in rows with a partition between each six bricks.

Asphalt and tar products, if sampled from tank cars, should preferably be sampled at the time of loading in order to secure truly representative samples. When this is done, portions of the hot material may be taken at intervals during the loading of the car and combined to form the test sample. When sampling from drums or barrels,samples should be taken from a number of drums or barrels in each load or shipment and combined to form the test sample. In the case of hard products care should be taken to reach the interior of the material and not to include the surface skin, together with any foreign material which may have become adhered thereto. Care should also be taken not to take samples in these cases from material exposed to the weather, and on which free water is standing. The sampling of corrugated metal pipe should preferably be performed at a fabricating plant, but owing to the intermittent shipment of these products, such a procedure is useless unless central purchasing in large quantities is generally practiced. When samples are taken after pipe has arrived on the ground, it is necessary to use a heavy pair of metal shears or a hack saw to remove the sample. On account of the work involved and the danger of damage to the sample, field methods of testing are particularly desirable in the case of this material. A field method of testing these products has already been devised and it is the speaker's opinion that its use will be more generally adopted in the future. The necessity for the use of glassware and chemicals is an objection to carrying such a testing outfit in the field.

Field Tests

In the field testing of materials, these various features in regard to sampling are just as necessary and should be followed out as carefully as when taking samples which are to be sent to a central laboratory.

The testing of materials in the field is naturally confined to these tests for which equipment may readily be manufactured which is comparatively inexpensive and easy to transport, and to those tests which do not require strict conditions of temperature or methods of analysis which can only be carried on in an enclosed room under exacting conditions. As stated before, the testing of such material as portland cement is a laboratory process. Sand, gravel, and crushed stone may, however, be examined in the field with a good deal of efficiency.

The testing of sand in the field is of considerably more importance than is generally recognized, both in connection with preliminary tests and with the control of material from known sources of supply. The tests which are ordinarily conducted on sand are tests to determine cleanness, both as to organic matter and clay content, size and grading, and strength in mortar. The latter test is essentially a laboratory test. The size and grading of sand may readily be determined by a set of field screens and sieves. The determination of quantity of clay and silt in sand may readily be made in the field on a volume basis by selecting a sample of the material, mixing it thoroughly, and cutting it down to a size suitable for testing. This small sample is then placed in a graduated glass cylinder together with water, and the whole vigorously agitated without whirling. The per cent of clay and silt, by volume, may then be determined by measurement of this material which is in the upper part of the cylinder and which may be readily noted by the eye.

Organic Matter in Sand

It is the speaker's opinion that the determination of organic matter in sand is one of the most important tests that may be applied to this material. The relationship between organic content and decrease in strength of both mortar and concrete has been quite definitely determined, and the low strength of concrete, in many instances, may be traced directly to this particular feature of the sand. Small variations in the properties of portland cement and other features of aggregate are of insignificant importance if organic matter is present in the sand in any considerable quantity. Fortunately this quality of sand may be determined in the field by a comparatively simple method. The test as it is usually made consists of thoroughly digesting the sand with a 3% solution of sodium hydroxide and observing the resultant color of the liquid above the sand after the mixture has been allowed to stand for a few hours. Then procedure may be briefly described as follows: A 3% solution of sodium hydroxide may be made by dissolving one ounce of sodium hydroxide (obtainable at any drug store), in enough water to make 32 liquid ounces. Fill a twelve ounce graduated prescription bottle to the 4½ ounce mark with the sand to be tested, add the 3% solution of sodium hydroxide until the volume of the sand and the solution, after shaking, amounts to seven ounces. The mixture should be shaken very thoroughly and allowed to stand for 24 hours. If the solution resulting from this treatment is colorless, or has a light yellowish color, the sand may be considered as practically free from organic impurities and satisfactory for use in so far as this quality is concerned. If on the other hand, a dark brown colored solution is obtained the sand should not be used for concrete aggregate. The time indicated above, 24 hours, is usually the standard time allowed for settlement of the solution. A very good idea of the character of the sand, however, may be obtained in a much shorter period.

The size and grading of gravel and crushed rock may be obtained very easily by means of a compact set of field screens and sieves.

Testing Water Supplies

Occasionally one desires to use a source of water for concrete which appears questionable. Simple tests can be made in doubtful cases to determine whether any supply is objectionable. Strips of red and blue litmus paper (which may be obtained in any drug store) can be used by inserting them in the water for a period of five minutes and noting the color produced. A marked reversal in color indicates the presence of acids or alkalis, and makes further laboratory tests advisable. Laboratory tests usually consist of determination of total solids and quantity of organic matter present, or a comparison of the given water with a water of known satisfactory quality by making standard tests of a sample of cement which is known to be satisfactory.

An important part of the work of field control of materials is in connection with the control of cement concrete entering into either concrete pavements or other concrete structures such as bridges, culverts, retaining walls and other similar structures. Due to the large amount of investigative work which has been completed in the last two years, we know a great deal more about the importance of certain features in connection with the manufacture of cement concrete than was the case a few years ago. Time of mixing, method of curing, and the consistency of concrete are now recognized as among the most essential elements affecting the finished product. Time of mixing and method of curing may be easily controlled by the field forces on a construction project.

Consistency of Concrete

Consistency or the per cent of water in concrete is another item which has often been neglected in the past, but which is now receiving more careful attention on the part of construction organization. We know beyond a doubt that a dry concrete is much stronger than a wet concrete, all other conditions being equal. Two methods have been devised for determining the consistency of concrete, only one of which is readily adaptable for use in the field. This method is known as the "slump" test and is conducted by placing concrete, fresh from the mixer, in a metal mould twelve inches high, eight inches in diameter at the bottom and four inches in diameter at the top. This form is placed on a level and preferably on a non-absorbent surface, such as a metal plate. The concrete is placed in the open end in approximately three layers, each layer being rodded with a half inch or five-eighths inch steel rod, preferably pointed at the end. After the form is filled the rod may be used to strike off the concrete level with the top of the form. The form is then carefully removed by raising it in a vertical direction and the distance which the concrete slumps down, or in other words, the difference between twelve inches and the remaining height of the concrete after the form is removed, generally denoted as the "slump," is considered as a measure of the consistency of the material. The entire apparatus for this simple field test can be obtained at a cost of two or three dollars, and if kept properly cleaned, may be used for several seasons.

Tests of the concrete itself may be conducted in a laboratory by taking specimens for tests of compressive strength, wear or cross breaking strength. Probably the most logical test to use is the one involving the cross breaking strength of the material. This test, however, unless laboratory facilities are provided very close to the work is impracticable on account of the necessarily large size of the specimen and the cost of transporting it to the laboratory. Compressive strength tests or tests for wear have generally been utilized to a greater extent.

Testing at the Plant

We have referred to the general plan of laboratory testing. Laboratory testing may be conducted in a central laboratory or in a temporary laboratory connected with or near the manufacturing plants at which the materials are actually produced. Plant testing depends to a great extent upon economy in connection with such procedure. When an organization is obtaining a large volume of the products of any given plant it may often be economical to test the product at the plant itself. This method is by far the most convenient one on account of the fact that the quality of materials can usually be determined and results of tests made known on the job prior to shipment or receipt of the material. In this connection the testing of portland cement offers one place where plant testing may often be followed economically. The use of aggregate of either sand, gravel or crushed stone on a large scale always makes it desirable to follow up inspection of these materials at their source. As in the case of portland cement these materials can readily be tested at the plant, and their quality determined prior to shipment. In connection with aggregates it is extremely important that the plant inspector actually inspect the loading of each car of material.

Bituminous materials such as asphalt cement and various tar products may also be properly tested at plants.

Where plant testing is not followed it is desirable, in the case of such materials as portland cement, asphalt and tar, to station samplers at these plants and have samples taken at the time of shipment, which may be transmitted to a central laboratory and test results obtained as soon as possible after receipt of the samples. Plant samplers in these cases usually consist of men who do this work in addition to some other duties.

In the case of large organizations embracing a rather large area of territory, the establishment of branch laboratories in connection with the main laboratory for testing materials may be followed out economically, and will serve to measureably increase the facilities for the inspection of materials.

We have already discussed the various properties of portland cement, dividing them into three classes according to the time necessary to complete tests. These properties may also be divided into two other classes; into one of which we would place those properties which are unchangeable, or very nearly so, in their nature; into the other class we may place those properties of cement which may undergo changes. Under the first classification we have such properties as fineness, and to a limited extent, tensile strength of standard mortar. In the second classification we may place the properties of time of setting and soundness.

When a cement upon original test fails on fineness it does so because of the fact that the material is not ground finely enough to meet the requirements of the standard specifications for size of particles. This property is changeable only to a very slight extent and hence rejections on this property do not warrant re-testing of cement unless sampling has been performed in an entirely unsatisfactory and improper manner.

If a cement fails on time of setting or soundness, the user, if he desires to hold the material for a retest, may properly request that another sample be taken and tested from a certain load or shipment which has previously failed on either or both of these tests. The user, whether a contractor or an organization, whichever the case may be, must necessarily resume all the responsibility for the cost of holding the material for this re-test.

In the case of failure of cement due to low tensile strength, a considerable amount of time is necessary in order to complete a second test. Therefore, the matter of economy enters very materially into the question of retesting.

Administration of Laboratory Work

It perhaps may not be out of place to refer to some features in connection with the administration of laboratory work. On account of the fact that laboratory tests of materials involve shipments of considerable value, it is absolutely essential that the work of testing be carried on by efficient workmen, thoroughly trained, and performing their work according to certain definitely outlined methods. Methods of examination of materials used in highway improvement have been very largely the result of work done by organizations such as the U. S. Bureau of Standards, U. S. Bureau of Public Roads, The American Society for Testing Materials, The American Society of Civil Engineers, Engineering Institute of Canada and other like organizations. At the present time the testing of these various materials has been placed on a rather standard basis, and the work of testing carried on throughout the country is rapidly becoming more and more standardized, using more uniform methods.

It may readily be seen that extreme accuracy is necessary in the conduct of this work, and that an error due to lack of training or carelessness is very much more serious than often is the case in connection with construction work itself. For this reason the training of men engaged in this work becomes of paramount importance.

In the laboratory of the Michigan State Highway Department, both technical and non-technical men are utilized in the examination of materials, each working in the sphere for which he is particularly fitted. Operators on portland cement who conduct physical tests only are not permitted in the case of such tests as time of setting, soundness, and tensile strength, to perform routine tests until they have passed through a period of training of from two to three months, working under the direction of experienced men. In many cases this period has actually, on account of existing conditions, been extended to far greater periods. The same is likewise true with reference to other materials and every effort is made, in the cases of failure to meet certain specification requirements, to carefully ascertain by means of check tests that the results obtained are correct.

Promote Proper Use of Materials

The work of a testing laboratory is not confined entirely to the routine testing of materials. Many other duties are part of a laboratory's responsibility. In addition to the routine testing of materials it should be the duty of a laboratory to assist in the proper usage of materials, to aid in the advancement of knowledge of materials, by conducting investigations and work of a research nature, and by assisting in ascertaining and recording the extent and properties of local materials available for use; also by assisting in the preparation of specifications for materials. It should also be the duty of a laboratory to keep a record of materials tested in such a way that at any time the nature of materials entering into any given portion may be quickly and accurately determined. Last, but not least, the utilization of a laboratory in the training of employees in the use of materials is most certainly a valuable and essential part of its work. This function of the laboratory cannot be measured in the number of tests conducted, or quantity of material represented by tests, but is nevertheless a very important service to public organizations.

The co-operation of a central testing laboratory with field forces, involves not only accurate and speedy service on the part of the laboratory, but a willingness to assist field forces in every way possible. The administration of laboratory work along these lines is essential to the efficiency of the organization with which it is connected to insure the obtaining of materials of proper quality, the proper usage of materials on work, and the recording of data of value to the organization it serves.

Comparison of Sub-Drainage by Deep Side Ditches and Tile Drains

The Importance of Stabilization of Road Foundations—Consideration of All Factors Points to the Desirability of a Combination of the Ditch and Underdrain

By CHARLES M. UPHAM

Before the eighth annual conference on Highway Engineering at the University of Michigan

Sub-drainage is another way of saying stabilization of sub-grade or road foundations. Although we may go into this subject very carefully, very scientifically, and with much detail, we simply mean excluding moisture from the roadway, or draining moisture away from the roadway. If we look over some of the earlier highway literature we find that one of the most emphasized details of construction was drainage of the highways. Nearly everyone would talk drainage and plan for drainage systems, but when they commenced to construct a road the drainage system was generally excluded on account of its cost, and this money was usually spent in the construction of the surface. That this was an unwise practice has been too often proven. Considerable scientific data are now available which gives us more information relative to the regulation of moisture in the sub-grade and the practice of stabilizing road foundations.

I think it is safe to say that, at the present time, road surfaces are standardized to a degree, at least, that we can practically be assured of satisfactory results if constructed in accordance with standard specifications. In many roads we have had sections of the road surface break up, while in other places it has proven strong enough to carry the traffic. Investigation has shown that the cause of the failure was not due to the road surface itself, but on account of the failure of the sub-grade or road foundation. This has commenced thorough investigation of this subject, and therefore very long data will be collected and assembled so that the results of various researches will be made available for practice. It is practically accepted that the bearing power of any soil or sub-grade will vary inversely with the amount of water that the soil or sub-grade contains. With this fact to work upon it is readily seen that the more water present in any soil the less will be its bearing power or carrying capacity.

Effect of the Kind of Soil

The extent of the effect of moisture on any sub-grade depends upon the kind of soil in the sub-grade, so that it is readily seen that the selection of soils which go to make up the sub-grade is one of the most important factors in road construction. This detail is many times overlooked. In clay soils it has often been found that the soil nearer the surface of the ground is more satisfactory for sub-grade construction. This undoubtedly is due to the fact that the soil has been broken up due to the action of frost, and that the finer material and colloidal matter has been washed out by the rains.

In the South there is what is known as top soil, which is a sand-clay composed of broken down rock, from which the finer colloidal matter has been washed. With the varying effects of moisture on the different materials it can be seen that the selection of soil for a sub-grade is very important, and it is absolutely necessary to get a material of low capillary attraction and resulting high bearing value in the top of the sub-grade. Many times the mistake has been made of taking all material from cuts and throwing it indiscriminately in the fills, whereas it would be to the great advantage of the road to select the material generally from the top of the cut and place this material on the top of the fill. In that way we would have the better material in the top of the sub-grade and this would afford a higher bearing power for the construction of a road surface, which would have the same effect as increasing the depth of the slab.

There may be many methods of stabilizing sub-grades. We cannot imagine any road so muddy and unserviceable that we could not build up a sub-grade by putting sufficient number of rocks or crushed stone in the sub-grade. We could also go to the other extreme of imagining a sub-grade constructed of solid concrete, and there are other impractical methods of stabilizing sub-grades, but on account of large mileage of roads which must be built, and on account of the comparatively small amount of money available for road construction, it is absolutely necessary that the most economic means possible be used in stabilizing the sub-grade.

Stabilizing the Sub-grade

It has been found and accepted by road builders that the most economic method of stabilizing the sub-grade is simply to take away the water from the road foundation, or, better still, keep the water from getting into the sub-grade. Therefore, one of the first principles in road construction is to so construct a drainage or sub-drainage system as to pipe away all springs or water from any source whatever, so that at no time would it be possible for any of this water to enter the sub-grade and thus reduce the bearing power of the sub-grade.

This can generally be done by constructing ditches parallel with the roadway, the bottom of which are from 10 to 18 inches below the sub-grade or foundation of the roadway. When a road is hard-surfaced it prevents any water from above entering the sub-grade, at least until it has run to the edge of the pavement. The lateral side ditches intercept any water from horizontal capillarity or side seepage. There only remains then the water which rises up through the ground by capillary action. This is the most difficult and expensive water to take care of, and it can readily be seen that on account of the capillary action varying in different soils the selection of sub-grade material is very important. It can safely be said that the amount of water drawn up into the sub-grade depends upon the supply and the class of material in the sub-grade. Generally speaking, the coarser the material the less the capillary action, and also the reverse is true to the extent that the finer the material generally the greater the capillary action, although within certain limits the capillary action in the coarser material is quicker than in the finer material, but the ultimate amount of water raised, and the height it is raised, is not so much in the coarse material as in the finer material. And inasmuch as it is the amount of water present in the sub-grade which influences the stability of the sub-grade, it can be seen that in selecting material for the road foundation the coarser material should be selected.

From experiments performed by the U.S. Bureau of Public Roads it has been determined that the capillary water in a sub-grade is greatest directly underneath the hard surface slab, which means that the part of the sub-grade which should be the most stable is in reality greatly reduced in bearing power. However, the problem is to substitute for this portion of the sub-grade a material which is less affected by the amount of water, or which has lower capillary action, which also means, that the water does not rise so high in this particular selected material, and this is another way of saying that the sub-grade is more completely stabilized by this selected material, because the amount of water in the sub-grade directly underneath the slab has been excluded by the selected material.

Side Ditch and Tile Underdrain

Various cross sections of roadways have been designed for the purpose of doing away with these various conditions, and of course, one of the universal solutions of cross sections is the side ditch, which intercepts any water from the sides, which would otherwise get into the sub-grade. This brings us up to the comparison of the side ditch and the tile underdrain, which generally consists of a ditch at the bottom of which is a pipe laid with loose joints and then the ditch filled in with crushed stone.

It has been thought by many that since this was called a drain it effectively drained all the water from the sub-grade, but undoubtedly, in many soils this drain did little or no good other than to intercept any free water which might otherwise find its way to the sub-grade. In other words, it is quite likely that this drain was only effective in taking away free water which came from the surface or seeped through the ground horizontally.

It is quite doubtful if any drain ever carried away any appreciable amount of water which rose by capillary action. Therefore it can be seen that neither the open ditch nor the tile underdrain is sufficient to cope with the capillary water in any sub-grade. We must, therefore, design against capillary water in addition to the longitudinal drains.

Location of Tile Underdrains

In the subject of tile underdrains there is a question as to their location. While the longitudinal underdrain will serve the purpose of intercepting water which would otherwise find its way to the sub-grade, quite often transverse drains are necessary for the purpose of taking away water from springs or stratas which carry water underneath the road. The number and location of these drains absolutely depends upon conditions, and the amount of water which finds its way underneath the roadway. To carry the question of transverse drains a little further, and to more completely develop the idea, selected material which can be easily drained is sometimes placed underneath the road surface in thicknesses varying above two inches. This material should be connected up by drainable material to the nearest drain or ditch. This is another very effective means of reducing the amount of water underneath the road slab which is a means of increasing the bearing value of the sub-grade or road foundation.

The location of a lateral or longitudinal drain has been the subject of considerable discussion. One suggestion is to place the drain directly underneath the ditch, but this seems to be the improper place on account of water flowing in the ditch carrying the finer silt particles into the drain, which gradually make it less effective. It is undoubtedly better to construct the drain higher up on the shoulder and a little nearer the roadway surface.

There are many methods now being devised for the treatment of sub-grades in order to overcome the water of capillarity, and to insure more complete stabilization, various chemicals are being used to experiment in the treatment of sub-grades. Water-gas tar is a substance which has been used in sub-grade experimentation. Other experiments show that portland cement has an advantage in stabilizing sub-grades. Experiments with low capillary material suggests that cinders, sand, gravel, or crushed stone will bring about a stabilized sub-grade only in a different manner. In all cases, the treated or selected sub-grade material should be connected with the tile drains or ditches or drainage system, by means of the most drainable material, and the sub-grade, even if built of selected material, must be so constructed as to drain as completely as possible.

Not a Cure-All

We are now to the question of the comparison of the open ditch and tile drain. Neither of these is a cure-all. In some instances they help materially, but in other cases their effect is slight. There is a particular experiment which has been watched for several years. It is a surface treated macadam road. This particular road broke up every spring as the frosts came out of the ground. A complete investigation was made and what remained of the macadam surface was cleared away and although it was expected to find a spring underneath the roadway, the only thing which was found was a layer of clay slightly over an inch in thickness. This layer of clay was slightly tilted to such an extent that water would percolate through the ground until it reached this layer of clay, and then on account of the impervious clay layer it would follow along on top of the clay and appear underneath the road surface. This amount of water on top of the strata of clay so weakened the road surface and subgrade that it broke up each year. It was noticed that this stratum of clay was underlaid with a very coarse and easily drained sand, and the water which had collected on the clay strata was easily drained down through the holes cut in the clay strata. This matter is being mentioned in order to show that the flow of water in certain soils is very slight and that tile drains will have very little beneficial effect.

In many instances it has been found that the flow of water in different soils varies from one foot a day up to twenty or thirty feet a day in clay soils. There is some question relative to the depth of drains and ditches. It is very evident that a ditch will intercept water the same as a tile underdrain, and also the tile underdrain will have the same effect in intercepting water as an open ditch. It is assuming that both are maintained. It is quite evident on account of the fact that in tile drains the pipe is always available for the free water, whereas if an open ditch becomes stopped up the free water is backed up and allows a bigger supply of water for capillary action in the sub-grade. The deeper the ditch the more difficult it is to maintain, and one more important point is the fact that a deep ditch must be maintained by hand, which should eliminate this kind of a ditch for consideration only where the depth of the ditch is necessary for water drainage. In many instances a shallow ditch can be maintained by a road machine.

The value of a tile drain is sometimes completely lost under certain conditions of frost, and in many instances the effectiveness of a tile drain is practically of no value, although there may possibly be a very slight movement of water through frozen ground. This, however, is very slight. In this particular instance, no doubt, the open ditch would be more effective, especially in taking care of any surface water, which through certain weather conditions such as a thaw, might be present.

The Best Plan in Time of Frost

Probably the most critical time for any road is after the ground has been frozen for some two or three feet. Under these conditions the effect of the tile drain would be greatly reduced. If this freeze is followed by a thaw the surface of the road is first affected and this condition brings about an excess of water on the surface of the road and directly underneath the slab. On account of the frozen material underneath, the free water cannot pass down into the drain and thus, in this instance, the value of a tile underdrain is reduced to a minimum. A more effective solution in this case is a shallow gutter. By this is meant a gutter from 10 to 18 inches below the subgrade with the shoulders and slopes so constructed that surface waters and any free water occasioned by a thaw can readily find its way to the gutters.

It is assumed that all underdrains and ditches are constructed to grade and will thus quickly carry away any free water. Another very important point is that any free water which might for any reason exist in the subgrade must have a method whereby it can pass off immediately to the drain or ditch. In the case of ditches the existing conditions must be thoroughly studied before the location and depth is determined. If you are constructing a road on a fill, of course, there is no water to intercept, but in a cut which is on light grades or on side hill work, an intercepting ditch is very effective. On the heavier grades it is not necessary to make the ditch as deep as on the lighter grades, for the grade of the roadway has the same effect as the deeper ditch. If the ditches drain readily, all indications seem to point out that it is seldom necessary to construct any ditch deeper than 2½ feet or 3 feet below the grade of the road. It is sometimes necessary to do so to get a suitable grade to drain the system.

Comparisons of Ditch and Underdrain

In summarizing, no distinct advantage can be claimed for the tile drain above the open ditch; nor can it be said that the open ditch is more favorable at all times than the tile drain. But there are certain conditions where a combination of the two will be the most practical. If an open ditch is used there is no advantage in making it any deeper than to intercept water, and should not be so deep that it cannot be maintained by machine; otherwise the maintenance will be a costly item. An open ditch can be used to intercept water as effectively as a tile drain. The open ditch must be constantly maintained and presents a hazard to traffic. On the other hand, a tile drain will serve as well as an open ditch when used to intercept water from getting under the roadway. The maintenance of a tile drain is generally less than the open ditch, although many times its original cost of construction is greater. At no time does the tile drain present any hazard to traffic, and for this reason it should be given serious consideration.

Undoubtedly no decision can be made to the extent of stating that either the open ditch or the tile drain is preferable, but it can safely be said that there are conditions when it is more economic and desirable to use either one or the other. After a careful consideration of all the details it is quite likely that a combination of the open ditch and the tile underdrain is more suitable than either the one or the other.

In no case is it necessary to construct the open ditches or tile drains lower than that point which will intercept water, for, in practically no instance, do the drains reduce the amount of capillarity, and after all a combination which will most economically reduce the amount of moisture in the subgrade is the method to be selected, taking into consideration the first cost, cost of maintenance, and giving due consideration to any hazards which might be interposed on account of the open ditch.

A $3,000,000 Temple at St Anne de Beaupre

A temple costing $3,000.000 is to be erected in Ste. Anne de Beaupre to replace the destroyed one, according to an announcement made by the Redemptorist fathers, as well as a monastery of $500,000 to provide accommodation for the residing fathers. It was stated that in view of the importance of the work a contest may be opened to architects, carrying a prize of $15,000. The new basilica and its annex is to be fireproof.

Meeting of the Main Committee of the Canadian Engineering Standards Association

The seventh meeting of the main committee of the Canadian Engineering Standards Association was held in Ottawa at the offices of the Association on April 24, Mr. H. H. Vaughan being in the chair. This meeting being the first held since the death of Sir John Kennedy, the resolution of condolence which was passed by the Committee in November last was reported as having been forwarded to Lady Kennedy, and the chairman and other members of the Committee spoke feelingly of the loss sustained by the Association through Sir John's death.

The following changes in the personnel renominations of members of the main committee were reported: Sir Alexander Bertram, nominated by the Engineering Institute of Canada, replacing Mr. Tye; Mr. O. W. Lefebvre, nominated bv the Ecole Polytechnique, replacing Mr. A. Surveyer; Dr. L. A. Herdt, renominated by McGill Universitv; Dr. R. A. Ross, renominated by the Research Council; Prof. P. Gillespie, renominated by the University of Toronto; Mr. T. F. Sutherland, renominated by the Canadian Institute of Mining & Metallurgy; Mr. A. R. Goldie renominated by the Canadian Manufacturers' Association. Mr. W. A. Bowden having been nominated as a member of the main committee by the Department of Railways & Canals, replacing Colonel Monsarrat, it was decided to co-opt Colonel Monsarrat as a member so as to retain his services on the committee.

The secretary's report on the work and progress of the Association up to March 31st was laid before the Committee and approved for distribution to members of the Association. Discussion followed on various points of interest. Of interest to the readers of the Contract Record was the discussion by the main committee, as a result of a communication from the Sub-Committee on Concrete and Reinforced Concrete, of the best means of dealing with the standardization of sieves and screens in Canada. It was pointed out that standards of this kind have been adopted both in England and in the United States, and that the question is of great interest not only to persons interested in cement and concrete but also to the mining and metallurgical industries, to those dealing with road materials, broken stone, etc., to industrial chemists, and others. It was decided that the formation of a committee to deal with this question should be proceeded with, and the matter was referred to the executive committee for action.

Election of Officers

On the motion of Dr. Porter seconded by Mr. Mountain, it was unanimously resolved that Mr. H. H. Vaughan be appointed Chairman of the C.E.S.A. in succession to the late Sir John Kennedy. Mr. Vaughan expresed his willingness to accept the honor thus conferred, and pointed out that, in his view, the thing which was now most necessary for the success and growth of he C.E.S.A. was the encouragement of an effective interest in the work of the association on the part of the manufacturing and industrial industries, this support being just as important and advantageous as the assistance rendered by engineers or scientific and technical societies.

The election of Mr. Vaughan as chairman requiring the appointment of a second vice-chairman, Messrs, T. A. Russell and D. H. McDougall were unanimously elected as vice-chairmen, together with Dr. J. B. Porter as honorary secretary-treasurer, these gentlemen, with the chairman forming the executive committee.

The meeting of the main committee was followed by the fourth ordinary general meeting of the association, at which the annual report on the progress of work was presented, together with the auditor's financial statement for the year.

New Model Erie Steam Shovel

The Erie Steam Shovel Company announces a new 20-ton "B" Erie shovel, which is a redesign of the 1920-21 "B" shovel. On the new 1922-23 Erie the object has been to provide extra protection against accident and abuse at every point. To accomplish this some parts have been increased in size, even though already heavy for the service intended. The new machine has more power it is claimed, than previously found on steam shovels in the 20-ton class—hoisting power enough to handle a full size ¾ cu. yd. dipper (water measure) even with a 21′ boom and 18′ 6″ dipper handle.

Improvements in the trucks are many, and include a reinforced truck frame of strong design and heavier propelling shaft. Split collars are provided on the rear axle, for throwing the propelling gears on a traction wheel shovel out of mesh in a few minutes' time, so that the shovel can be towed behind a motor truck at a speed of 3 to 4 miles per hour.

The 1922-23 type "B" Erie steam shovel shows a number of improvements

The traction wheel mounting of the new 1922-23 Erie is interchangeable either with car wheels or with the Erie's lubricated caterpillar type mounting, introduced last season. The turntable casting has been reinforced with flanged webs for greater strength, and has guards to keep water off the cone-roller path so that this path remains absolutely dry and the rollers do not slide.

New features of the operating mechanism include a new boom hoist design which provides instant accessibility for the hoisting engine crank shaft bearing. The hoisting engine crank shaft is heavier, making the engines run more smoothly and for a longer time without adjustment. There is also a new and better 3-feed oil pump for positive lubrication of the hoisting, swinging, and crowding engines.

Another improvement on the Erie is the new design of the main swinging shaft bearing, by means of which the bushings can be easily renewed in a few moments, by the insertion of interchangeable bushings of a special bronze. Smoother operation at high speed has been assured by machine-cutting all gears on the hoisting, swinging, and crowding trains—even the bevel gear and pinion at the beginning of the swinging train being machine-cut instead of cast.

Improvements have been made in the boom to provide still greater strength in hard digging, the supporting lugs being placed outside of the boom, so as to compact instead of spread the boom members when the boom is subjected to twisting strains. The heavy steel shipper-shaft boxes on high lift machines are cast together, eliminating all chance of the boom "spreading."

Another entirely new feature is the automatic tripping device. A drum turns with the shipper-shaft and keeps the trip rope taut, automatically winding and unwinding the trip rope as the dipper handle is moved in or out. There is no time lost overhauling rope in order to dump the dipper—the drum takes up all of the slack. The dipper is provided with a double-hinged latch lever and has been strengthened by a heavier lip, and also stronger hinges.

Many improvements have been made at the power-producing end of the new machine—notably a larger boiler. To economize fuel, the new shovel is equipped with an auxiliary exhaust—a new feature which permits exhausting to the rear of the shovel instead of through the stack, at times when the large boiler is providing ample steam and induced draft is not required. This new auxiliary exhaust feature is also of great advantage when the shovel has been standing idle and water has accumulated in the engines, as this water can be blown out through the auxiliary exhaust pipe instead of projected through the stack preventing the dropping of water on the hot tubes and creating sudden contractions to cause leaking.

Other features at the boiler end include a safety guard on the water glass, tank water-gauge, hood and stack of improved design and new ash pan guard.

The new 1922-23 Erie can be quickly converted to a locomotive crane to handle a clamshell, orange-peel or a dragline bucket; or it is easily changed over to a steam hoe for trench excavation; or it can be readily equipped with triple-gauge trucks for railroad ditching. The above special classes of work are all in addition to the regular steam shovel service in road grading, cellar excavation, quarrying rock, stripping coal, excavating sand and gravel, etc.

A Larger Size P & H Excavator Crane

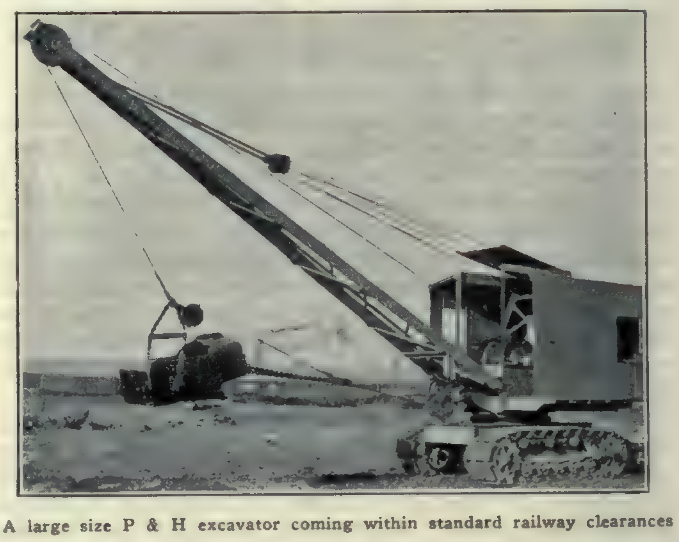
Owing to an increased demand for a larger size excavator designed to come within standard railway clearances without dismantling, the Pawling and Harnischfeger Co., has brought out the P & H 208 machine as a part of the standard P & H line.

This machine will handle a 1 yard Page dragline bucket on a 35 foot boom, a 3/4 yard Page bucket on a 40 foot boom or a ½ yard bucket on a 50 foot boom. It will also handle clamshell buckets of from 1/2 to 1-1/2 yards capacity depending upon the material handled. With but a few unimportant changes the 208 can be converted into a powerful gas shovel handling a one yard dipper. In addition to being used as a gas shovel or with clamshell and dragline buckets, the 208 machine can be used with backfilling scraper, crane hook or electric magnet.

The 208 is of rugged steel construction, of the full revolving type, and is one-man operated. Turned shafts, of forged alloy steel where necessary, are used. All gears are of steel with cut teeth. The corduroy traction are of the P & H self cleaning type having special high carbon cast steel treads and heat treated alloy steel link pins. The corduroys are completely available for inspection and renewals with a minimum of jacking. The ground bearing pressure is about 10 lbs. per square inch.

By means of independent gear drives on each corduroy the following motions may be accomplished:

1. A high speed forward and reverse on both corduroys.
2. A low speed forward and reverse on both corduroys.



A large size P & H excavator coming within standard railway clearances

3. A high speed forward and reverse on one corduroy and a low speed forward and reverse on the other interchangeably.
4. A high or low speed forward and reverse on one corduroy with other corduroy running idle, interchangeably.

All of these motions are controlled from the operator's platform regardless of the position of the revolving frame.

A 7-1/4 x 9—75 h.p. heavy duty internal combustion motor running at 500 r.p.m. is gear connected to the jack shaft, the connecting gears running in an oil tight cast iron case. Outside band clutches are used for connecting the engine to the jack shaft, and for the combined swinging and propelling shaft. Drums are mounted on separate shafts, the digging drum being provided with machine cut grooves.

The boom is hoisted and lowered by means of a drum operated by self-locking worm and worm gear enclosed and running in oil.

Operating levers are concentrated at the right front side of the machine giving the operator full view of the work. The machine is completely enclosed by a sheet steel housing.

Trade Incorporations

Coneybeare & Irving Construction Co. Ltd., with head office at Toronto, capital $40,000, to carry on a real estate and building business.

Chambers-McCaffrey Construction, Limited, with head office at Toronto, capital $50,000, to carry on a general contracting and supply business.

The Contract Record's

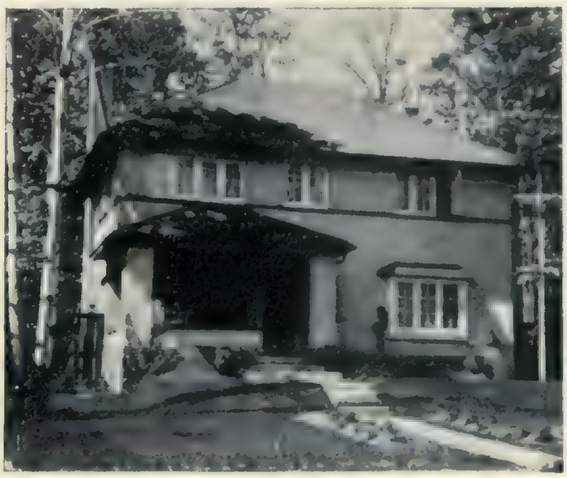
Weekly House Suggestion No. 21

The subject of this week's article is a square-plan, brick bungalow erected for Mr. Gordon Hunter on Inglewood Drive, Toronto. The foundation and walls are of brick with stucco facing from the base course up. The verandah is of masonry and steel construction with a tile floor on reinforced concrete. Wooden shingles, stained dark green, were used for roofing.

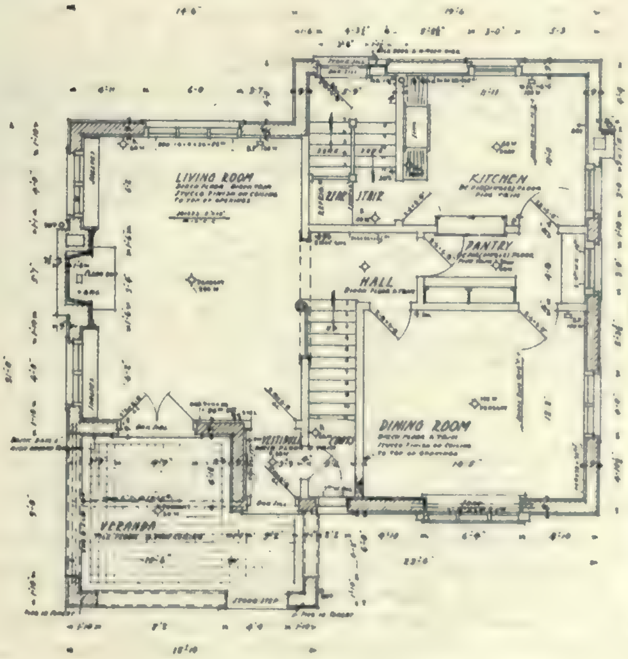
The first and second floor interiors need little description, the plans reproduced herewith being practically complete in every detail. It might be well, however, to point out a few features of this well planned home. It will be noted that the first floor layout combines the convenience of a vestibule with the bungalow feature of direct entrance on the living room. In most homes we have seen of this type, where the front entrance was directly on the living room, the vestibule was eliminated entirely. The kitchen and pantry arrangement in this plan is out of the ordinary too and contains several features that appeal. This section is desirably situated well apart from the living quarters, yet is conveniently accessible from the dining room—which is a necessary feature—through the second doorway seen in the plan.

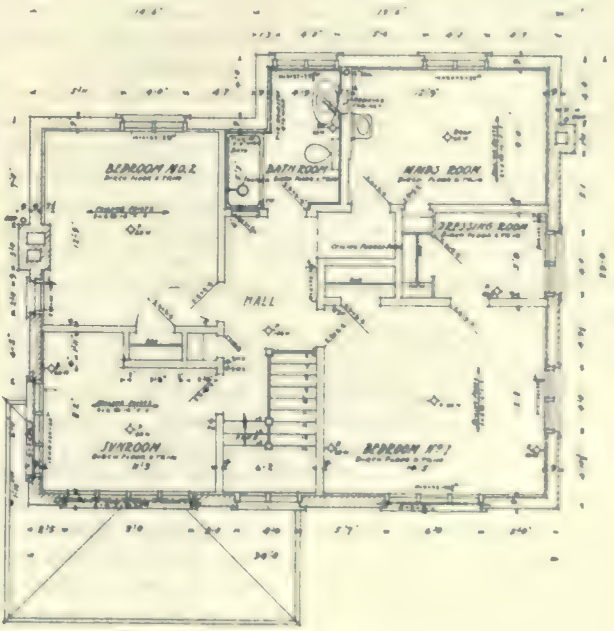
The bedroom flat shows all rooms conveniently situated off a square hall and all well provided with closet space. There is a separate dressing room off the main bedroom, as seen on the plan, and the bathroom equipment includes built-in bath and shower.

There is a basement under the entire area of the house, divided off into space for coal storage, fruit storage, heating plant and large laundry. The heating plant is of the hot water type.



Messrs. Molesworth, West & Secord, of 43 Victoria St., Toronto, are the architects who designed this residence.





Agents for Austin Equipment

The Canadian Fairbanks-Morse Co. Ltd., announce that they have been appointed sole Canadian agents for the Austin Manufacturing Company's line of road-making and maintenance machinery. The Austin line includes: motor road rollers, steam road rollers, motor sweepers, street sweepers, street sprinklers, road oilers, road scarifiers, rock crushers, elevating graders, and reversible graders.

Mainly Constructional

East and West—From Coast to Coast

Fire losses in Canada during the week ended May 17th, are estimated by the Monetary Times at $489,750, compared with $760,300 the previous week.

A recent fire at Laurierville, P. Q., resulted in the destruction of 22 residences at an estimated monetary loss of $150,000.

Appropriations of $850,000 for carrying on the work of improving Toronto harbor, and $50,000 for work on the breakwater at Toronto Island were voted without opposition in the committee of supply, House of Commons recently.

The Vancouver & District Sewerage Board at a recent meeting authorized a $600,000 bond issue to cover the cost of work to be undertaken during the balance of this year. As soon as the issue has been approved by the lieutenant-governor, tenders will be called.

Commissioner Harris, at Toronto, in a recent report to the Works Committee, states that he does not think it fair that the city should have to provide extra heavy foundations in pavements for the comparatively small percentage of heavy truck users. He has recommended to the Board of Control that the Load of Vehicles Act should be revised or municipalities be given the right to govern their own traffic.

Col. H. C. Boyden, of the Portland Cement Association, Chicago, addressed a recent meeting of the Border Cities branch of the Engineering Institute of Canada, at Windsor, on "Recent Developments of Concrete." The data presented in Col. Boyden's address was largely the results of tests at the Lewis Laboratory in Chicago, and a number of interesting slides were shown illustrating his remarks.

Specially designed machinery for the extraction of oil from tar sand has been manufactured in Los Angeles to the order of the Hammond interests, owners of large deposits of tar sand in the McMurray region, Alberta. The machinery is to be inspected by Mr. S. C. Ellis, government engineer. Much difficulty has been experienced in obtaining the successful extraction of oil from tar sand and the results from the use of this machinery will therefore, be awaited with interest.

The sum of $7,500,000 will be spent this year on good roads in Quebec, this money will be apportioned as follows: Regional roads, $3,450,000; municipal works, $2,100,000; rebuilding and upkeep, $1,450,000; special work and administration, $500,000. The general plan, taking Montreal as the centre, is that the highways of the Province shall stretch out to Hull, to Mont Laurier, to Lacolle, to Malone, to Sherbrooke, to Quebec and, with Levis as another spider-web centre, is the road to Jackman, Maine, the road to Sherbrooke and then to Derby Line, Vermont. Below Quebec is the long road to Rimouski and the road from Riviere du Loup to Edmunston, N.B.

Many changes in the bridges over the Niagara River at Niagara Falls, Ont., are proposed, present plans being along the following lines: A complete new structure will be built between the present cantilever bridge and the one used by the Grand Trunk and for pedestrian traffic. The contract for the new structure calls for its completion within two years. The lower bridge will be greatly extended. At present there are two tracks on the upper decks and vehicle and foot roadway on the lower deck. This bridge will be widened to one hundred feet in width. The upper deck will carry four railroad tracks. The lower deck will carry a double track trolley line through the centre portion. On either side of these will be a wide roadway for automobile or other vehicular traffic.

The Galt, Preston and Hespeler Builders' Exchange with headquarters at Galt, Ont., has been reorganized, with James S. Webster, Galt, president, and A. G. Robb, Galt, secretary-treasurer.

Tenders are being called at the present time on the largest construction contract in Canada or United States namely for the completion of sections 3 and 4 of the Welland ship canal. This work will include the excavation of about 4,000,000 cu. yards of rock and 26,000,000 cu. yards of earth, the laying of about 1,500,000 cu. yards of concrete, and the erection of locks 4, 5, 6 and 7. These locks will be the largest in the world, equalling an ascent of 139½ ft., each 800 ft. long, with 28 ft. of water on sills. The estimated cost of the work is $30,000,000 and a staff of about 2,000 men will be required to carry out the work. Mr. Alex. J. Grant is the chief engineer of the canal and Mr. F. S. Lazier is the divisional engineer for sections 3 and 4.

Personal

Mr. W. S. Caie, who was for a number of years with the Wayagamack Pulp & Paper Company and R. T. Gilman, has opened an office at 201 McGill Building. The name of his firm is the Sales and Purchasing Company. They will specialize in traffic adjustment.

Mr. John Digby Chick, of the Chick Contracting Company, well known firm of Windsor contractors, was made the recipient of a beautiful chest of silver and several floral remembrances from his many friends, at a dinner tendered him at the Windsor Club, in honor of his recent marriage Mr. John G. Vanderhoof presided at the dinner and Mr. A. F. Healy made the presentation speech.

Obituary

Mr. Hermigilde Dufort, building contractor of Montreal, died at his home in that city recently at the age of 71 years. Deceased was born in Montreal and had lived there all his life, having built a large number of the city's fine residences and public buildings. He erected the Montreal post office on St. James St. in 1871.

Mr. James Bews, of Kingston, Ont., died recently at the age of 77 years. Deceased was a mason contractor and had resided in Kingston for the past 44 years, coming to this country from Scotland at an early age. He was for some time in the employment of the city as a cement expert.

Trade Incorporations

Caledonian Construction Co. Ltd., with head office at Three Rivers, P. Q., capital $20,000, to carry on the business of general contractors.

McQuigge-Morse, Limited, with head office at Toronto, capital $100,000, to carry on the business of a general engineering and construction company.

Hanover Cement & Stone, Limited, with head office at Hanover, Ont., capital $1,500,000, to manufacture and deal in cement, lime, brick, etc.

Agnew Bros. Limited, with head office at Toronto, capital $40,000, to carry on the business of contractors and builders.

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The Canadian Good Roads association

Next week the Canadian Good Roads Association is holding its annual meeting in Victoria, B. C.—the first occasion on which this association has gone to the Pacific Coast for a convention of this character. In spite of this departure from precedent, however, officials of the organization anticipate one of the biggest and most instructive conventions ever held during the Canadian Good Roads Association's long and notable existence. To some extent, no doubt, the long distance from eastern points to Victoria will militate against a complete representation of the good roads men of the East, but this will be counterbalanced by the attendance of a greater number of Western delegates than have participated in previous meetings in central and eastern centres. Futhermore, with the convention in Victoria, facilities will be offered for the co-operation of the Pacific states of Oregon, Washington and California, which have worked in close affiliation with British Columbia in the matter of good roads. It must not be thought, however, that the East will not be represented, for we understand from officials of the association that many of the leaders of the highway movement from Ontario, Quebec and the Maritimes have signified their intention of attending. It may be expected, therefore, that the forthcoming meeting will be thoroughly representative and, consequently, expressive of the best highway thought of the Dominion .

In many ways, it was a happy thought that induced the executive of the Canadian Good Roads Association to decide on Victoria as the 1922 convention centre. Last year, it will be remembered, it met in Halifax, in so doing recognizing the pioneer efforts of the Maritime provinces for the furtherance of improved highways. This year it is fitting that the West's contribution to the good roads movement should be similarly recognized, for British Columbia and the Prairies have not been behind the older provinces in the promotion and construction of highways—in fact, the West can teach the East many excellent lessons in proper road building and maintenance. Explanations of this work will naturally be important elements of the agenda. In addition, of course, highway problems in general will be discussed from all angles in a program that is replete with papers and addresses—a list of these appeared in the Contract Record of May 24. From advance reports there is very indication that the Victoria meeting will be successful in attendance and in the results accomplished; in short, it is felt that the decision to meet in Victoria will be amply justified.

The Construction Situation

During May, construction contracts awarded in Canada, according to MacLean Building Reports, Limited, amounted to $34,827,300, compared with $29,428,400 in April and $26,859,500 in May, 1921. This is the second largest monthly figure on record since 1914. Residental buildings accounted for 45 per cent. of the May total and amounted to $15,633,500. Business buildings amounted to $11,516,000 or 33.1 per cent. of the total; industrial buildings, $801,500, or 2.4 per cent.; public works and utilities, $6,876,300, or 19.5 per cent. The value of contemplated new work reported during May, was $28,871,500.

The figures for the different provinces are as follows:—

Ontario	2,048	$20,012,200
Quebec	779	7,813,900
British Columbia	276	2,090,900
Manitoba	290	1,381,300
Nova Scotia	84	1,065,700
Alberta	162	875,400
New Brunswick	94	818,400
Saskatchewan ..	136	668,500
Prince Ed. Isl. ..	4	101,000
Total for Dominion	3,873	$34,827,300

"Covered by Insurance"

Newspaper accounts of fire invariably conclude with the statement "The loss is fully covered by insurance." We take it for granted that this means there is complete compensation for all waste and destruction caused by the fire. There is no greater fallacy. The losses resulting from a fire extend in so many directions that they can never be fully covered by insurance.

Insurance, at the most, can be collected only for the goods and property actually destroyed. Where the fire has been in a shop or industrial plant, no matter how fully the buildings and the contents may have been insured, there is no adequate compensation to that firm for the time lost from production while seeking a new location or rebuilding. There is no insurance on the unfilled business orders which may go to a rival concern and mean a permanent loss of trade. There is no insurance for the loss of employment suffered by the employees, many of whom may be compelled, temporarily, at least, to accept employment in other branches of industry at lower wages. There is no insurance for the loss of production suffered by the public as a result of the plant being put out of operation. Anything which reduces production and makes commodities scarcer necessarily influences higher prices. And yet these are the invariable results attendant, either directly or indirectly, on almost every shop and factory fire.

And what do statistics show in regard to these fires? That in the vast majority of cases they occur immediately following the departure of the employees for their homes. It means that in the rush of quitting time there has been carelessness. Some one forgot to shut a fire door. Some one failed to turn off some electric switches, some one neglected to remove a heap of inflammable rubbish. Some hurrying worker ignored the rules, lighted his pipe or cigarette before he passed out of the building and carelessly threw the smouldering match on the floor. It is the history of almost every big fire—indifference and carelessness. And the public pays the cost.—Fire Control.

A Bad Time to Bid Low

By CHARLES REYNOLDS.

Rumors that contractors in general are exhibiting a tendency to bid lower on all kinds of construction work than they were willing to do a few months ago raise the question of whether or not the present outlook justifies lower prices for construction work. The answer, according to the Associated General Contractors of America, based on an analysis of present prices, wages, freight rates, freight service, and probable developments of these factors in construction costs, is that it is a bad time to bid low.

The general level of prices has been going up for the past several months. All authorities agree that the business depression has reached the bottom, and we are on the up-grade. There is practically no exception to the rule that prices generally increase somewhat during the period following a depression when business is recovering. This is now occurring and will probably continue for at least six months to come. The long time tendency of prices will probably be downward for many years but for the present, and for some time, they are going up. From this point of view, it is not safe to cut bids on the assumption that prices of materials will be lowered.

Wages in many lines have been reduced rather severely during the past few months. Doubtless, many employers feel that they must come down still more. Unquestionably, in some places and in some industries, where wages are still at the peak, some reduction will be made, but a time of improving business is not a time when wages generally can be reduced. Immigration has been restricted in such fashion as to greatly reduce what has in past years been the principal source of recruits for the ranks of common labor. An increase in business prosperity will raise the cost of living and increase the demand for labor. Bids made at lower levels on the assumption that wages are going to be reduced cannot be made safely.

Much has been heard to the effect that freight rates must come down if prosperity is to return. The importance of this factor has been greatly overstressed. Business is improving and freight rates are staying up. Some reductions, it is true have been made and some more may occur, but the railroads have made only a beginning toward a recovery from a desperate financial plight in which they have been, and they will not willingly submit to any very drastic or very extensive reductions in their charges. Reductions in freight rates offer no justification for bidding low on construction projects.

It is perhaps quite as important that a contractor should get his materials when he wants them as that he should get them at the right price. At present, stocks of most things are large, and production capacity is not being used to the full. These conditions are favorable, but how long they will stay so is problematical. Demand is increasing. If the coal strike continues all summer, many industries will not be able to produce up to their normal capacity or perhaps even at their present rates. It seems impossible that contracts can be taken with any assurance of prompt deliveries of large quantities of material several months from now.

If business improves as is hoped, there is going to be a car shortage before the summer is over. The railroads are under-equipped both in cars and locomotives for handling the normal business of the country. Even if their equipment were all in good condition a car shortage would be the hardly avoidable accompaniment of the next period of even ordinary prosperity. But it is not all in good condition. There are nearly two hundred thousand more cars unfit for service than there ought to be under normal conditions of maintenance. If conditions were such that a car shortage existed of precisely this amount, two hundred thousand cars, it would be a very serious shorage. Low prices for construction work are not justified, if they are based upon the assumption that freight cars will always be available when they are wanted.

Anyone contemplating making a low bid on construction work should not do it on the assumption that materials are going to be cheaper, that wages will be lower, that freight rates will be reduced, that deliveries will be prompt, that freight service will be adequate and that all things will be harmonious, for not one of these assumptions is likely to be true.

Wide Variations in Tenders

The electrical contract for the Chemistry Building, University of Saskatchewan, at Saskatoon, Sask., was recently let to the Wheaton Electric Co., of that city for $20,930. The bids tendered for this work ran as follows: $32,100; $32,000; $30,000; $26,975; $25,850; $22,470; and $20,930. These figures are interesting in that they show that there is too great a discrepancy in the bids—a difference existing, in this of $11,170. between the highest and lowest tender, or a percentage of 35. This compares with a difference of $36,097.45 in the tenders of the plumbing & heating trade (with an expenditure of approximately eight times greater than that of the electrical) or a percentage of 19. The general contract tenders varied only by $34,905. between the highest and lowest bids, representing a discrepancy of 7.5 per cent.

The Chateau Frontenac Enlargement

An Unusual Piece of Construction, Notable for its Size, Architecture and Contracting Methods

The First Authoritative Description of an Outstanding Building Project Now in Course of Construction—the Extension of the Canadian Pacific Railway's Palatial Quebec Hotel—Its Construction Under Unusual Conditions a Tribute to the Contractor's Skill

It is not the intention of this article to deal with the architecture of this structure, except insofar as the details are of especial interest to the contractor and the engineer, but rather to take up the different steps of actual construction, as far as it has gone, and the methods employed to solve the many problems, with which the average building contractor is more or less familiar. In this particular case these problems have perhaps been somewhat uniqe owing to the type of the building, which is one not very frequently encountered in this country.

In order to give the reader an idea of the layout the accompanying sketch plan has been prepared, showing the location of the various parts, together with the situation of the plant used in the construction. From this sketch (fig.2) it will be seen that the portion constructed to date consists of three wings variously known as the Vercheres wing, convention hall, and service wings. The Vercheres wing immediately adjoins the existing building on the St. Louis Street side, and consists of ten stories and basement. The convention hall also faces on. St. Louis Street and comprises four stories and basement, while the service wing faces on des Carrieres Street, this street having been constructed under this contract between St. Louis and Mont Carmel Streets. The service wing, which has only two full stories above the basement, connects the convention hall with the old Mont Carmel wing, and completes what is practically a hollow square, with the main side the tower wing, and the court in the centre. The tower wing, construction on which is just being commenced, will be about twenty stories in height, with the ridge of the roof two hundred and fifty feet above the level of St. Louis Street.

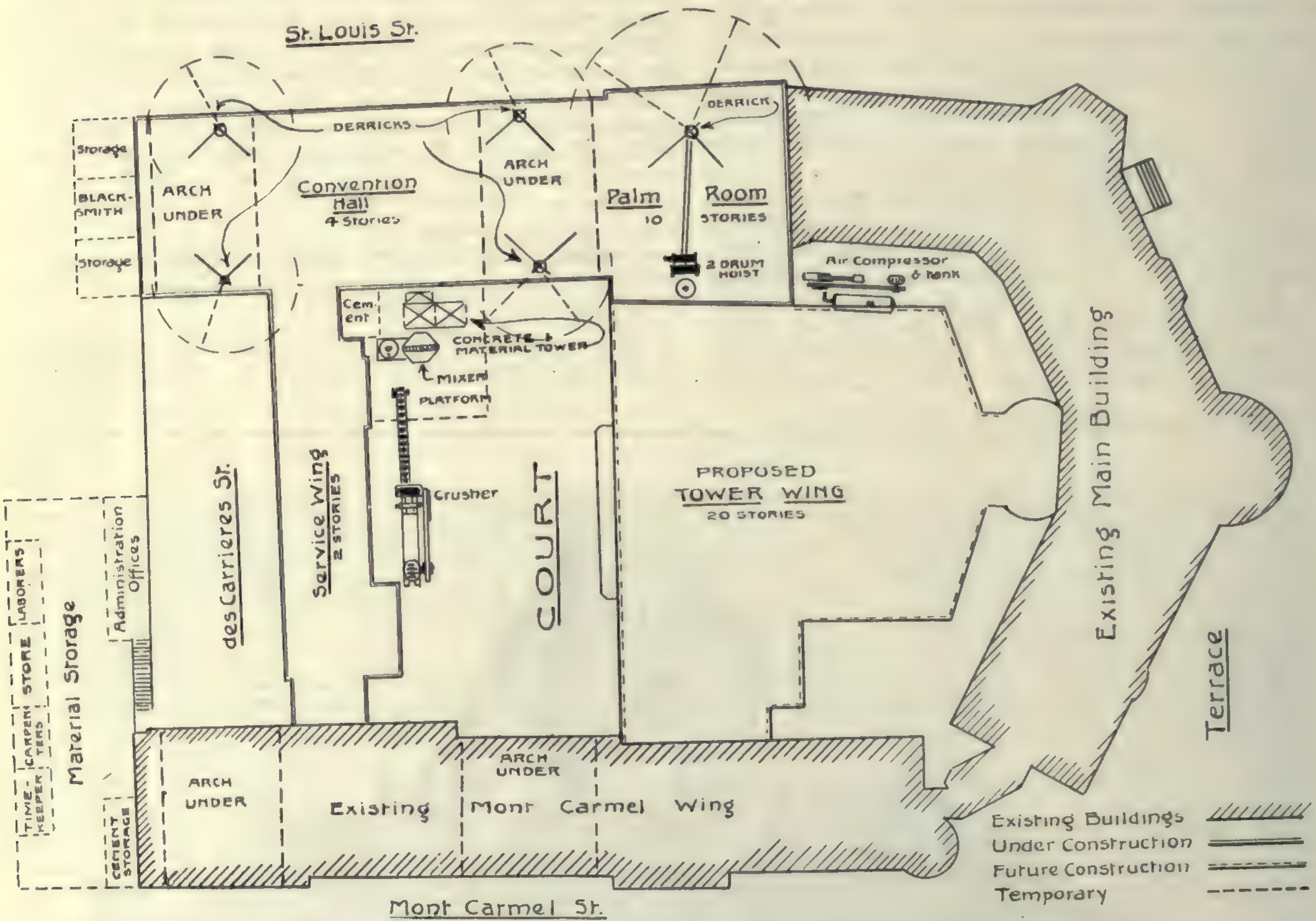
The style of the building conforms throughout with that of the present Chateau, and from the con-

The Chateau Frontenac, Quebec, as it will appear when completed tractor's point of view presents one of the most difficult types to be met with, owing to the irregularities in both lines and levels, and the fact that the details vary throughout the entire work.

The structure is entirely modern and up-to-date and of fireproof construction in all details, having a structural steel frame with concrete floor slabs and stone and brick walls. The foundation is on solid rock. All the important members such as columns, girders, floor beams and hip rafters are encased in concrete to a thickness of 2 in. outside the flanges. The interior partitions and wall floorings are of terra cotta hollow tile, and the roof is a composition of cement and asbestos on hyrib metal, superimposed with a two inch air space, one and one-eighth inch T & G boarding, rubberoid ready roofing, and copper sheathing.

Excavation

The excavation, which was in solid rock throughout, varied in depth from five to fifteen feet according to the different floor elevations and the contours of the ground. The rock is of limestone, interlaid with what is locally known as Quebec shale; it is of a very seamy nature and lies in slabs at an angle of about thirty degrees off the vertical. The usual difficulty in drilling in this locality was encountered, in that it is not feasible to prepare a second set of holes before blowing the first, unless doing so at some considerable distance. The reason for this, which is one well known to contractors operating in this vicinity, is that the second set will be almost entirely lost while blowing the first. It is also a common occurrence, and a very annoying one, to have the drills deflected from their course and jammed when drilling to any considerable depth.



General plan of old and new buildings of the Chateau Frontenac

The drills used in the deeper portions of the work were of the tripod type, self contained; that is to say, each drill carried its own motor and air compressor, the power being supplied from a 220 volt line off the local supply. In the shallower portions, running to eight or ten feet, Ingersoll-Rand jackhamers were used almost entirely, owing to their ease of operation and moving. These were supplied with air from the central plant.

Owing to the proximity to the existing hotel, it was, of course, necessary to take extraordinary precautions against damage from flying rock, but beyond a broken pane or two, the operations were entirely carried out without accident of any kind. For covering purposes brushwood and second-hand railroad ties were used, together with rope mats, the latter being woven locally for the job. In all there has been excavated up to date approximately 10,000 cubic yards of solid rock, and there still remains a considerable amount to be moved for the foundation of the tower wing.

Concrete Work

The foundation piers and walls and other plain concrete work are a 1 : 3 : 5 mixture, while the reinforced concrete is proportioned 1 : 2 : 4. The rock taken from the excavation was used pretty much throughout the concrete work. As there was some question as to this rock being suitable for concrete work, several tests were made of samples taken at random during the course of the work, and excellent

The St. Louis St., elevations of convention hall wing and Vercheres section

results were obtained, as will be seen by the report from the Milton Hersey Company which follows. The cubes mentioned in the report were taken from different batches while pouring one of the floors, the concrete being of 1 : 2 : 4 mix, and the stone used being crusher run containing everything except the finest of the dust. This test would tend to bear out the contention that run-of-crusher makes a more satisfactory concrete than that made with stone having the finer aggregates screened out. Following is the report:

"We have tested two of the eight inch cubes which you delivered to us on April 23rd and below are given the results obtained:

1. Area of cube, ... 64 square inches
   Time of setting, ... 17 days
   Broke at, ... 186,000 pounds load
   Compressive strength, .. 2,900 lbs. per sq. inch
2. Area of cube, ... 64 square inches
   Time of setting, ... 17 days
   Broke at, ... 188,000 pounds load
   Compressive strength, .. 2,940 lbs. per sq. inch

"This is a concrete of uniformly good quality, the strength being quite high and the structure of the

Showing new service wing in the centre, convention hall wing and Vercheres wing on the right, with structural steel for the tower in course of erection.

cubes indicating good mixing and proportioning of the aggregates."

In addition to the above test two other blocks were subjected to a twenty-eight day test, with the result given in the following report: "In carrying out 28-day tests on the two concrete blocks from the mix used in the Chateau Frontenac construction on April 8th the strength of one of the cubes of concrete was so high as to make impossible its breaking in a 200,000 pound testing machine.

"A load of 217,000 pounds was placed on the cube, this being the limit to which the machine can be loaded, but the block did not break under this load. The strength was, therefore, above 3,380 pounds per square inch and would probably be as high or higher than 3,600.

"The load of 217,000 pounds was held on the other block and at the end of a three minute period the concrete broke showing fine proportioning of the aggregate and a well-knit mix. The rock aggregate broke but did not pull away from the mortar. The strength of this concrete was 3,380 pounds per square inch.

"Cube tests are not so accurate as tests of cylinders of concrete and a long series of results on both shapes have proven that the actual strength of concrete is approximately 75% of that obtained on a cube test. In this case, therefore, the strength of the concrete can be considered as being about 2,500 to 2,800 pounds per square inch. This is a very satisfactory strength from this mix and indicates good mixing and proportioning of the aggregates."

It may be stated that the concrete used in the above tests was made before the screens were installed on the crushing plant. The reason for using the screens was not from any belief that a better concrete would be obtained, but simply because different sizes of aggregate were required in different classes of work.

The crusher itself was installed in the site of the court as shown on fig. 1, and the crushed stone conveyed by means of a bucket elevator to a platform fifteen feet high. On this platform two screens, one 3/8 inch mesh and the other of 1 inch, were erected, and the stone separated into different piles. Under the platform a 3/4 yard Smith mixer was placed, this feeding directly into the concrete hoist bucket, the mix being then hoisted and distributed from hoppers through chutes to the various floors. The fine stone and dust passing through the 3/8 inch mesh was found to be of great value in pouring the fireproofing of the columns and hip rafters, as it worked its way through the mesh wrapping and into all the odd corners in which pockets are so liable to form in work of this description. As a matter of fact the results obtained were vastly more satisfactory than even pure cement and sand, so much that the labor foreman guards his stone dust as he would his pocket book, and woe to anybody found using it for other than concrete work. The difficulties with regard to the fireproofing were, of course, more pronounced in this building than is usually the case, owing to the steep sloping roofs, hips and valleys, and the many dormers, turrets, etc. The first screened material was also used for the finishing of sidewalks and floors, the finishers finding it easy to float, and giving a satisfactory surface.

Elevations of new service wing, convention hall wing and Vercheres wing from new Court.

The material rejected by the 3/8 inch screen and passing through the 1 inch screen was used principally in the fireproofing of the floor beams where space was more available than in the columns. In some cases it was re-mixed with the larger stone and used in the thicker slabs. It was also found to be useful in pouring thin walls, such as three inch dormer side walls and slabs, and other work where the larger stone would not conveniently pass.

Distribution of the Concrete

For the distribution of the concrete many and varied methods were used, but the bulk of it was conveyed, as before stated, by means of the usual concrete tower. During the past winter a low tower was placed at the storage shed on the site now occupied by the construction office. The stone and sand were heated in this shed by means of steam coils, and the concrete was conveyed across the newly opened street in a chute and deposited in the service wing and the foundations of the other wings.

As soon as the weather permitted of mixing without heating the ingredients, a more centrally located tower was erected in the new court, and equipped with a bucket in one shaft and material platform in the other. Three discharge hoppers were erected on this tower at different elevations, so that it was necessary only to arrange the spouting when shifting the scene of operations, which had to be done at frequent intervals. This tower was used in concreting nearly all the floors of the various wings and the court slab, but in order to reach the three upper floors of the Vercheres wing it was found necessary to erect a supplementary elevator. This latter was placed in a stairwell and extended to the ninth floor. In this case the concrete was conveyed as usual by means of the spouts to the fourth floor of the Vercheres wing and there discharged into buggies. From this floor the buggies were conveyed, two at a time, on the supplementary elevator to the desired levels. Owing to the sharply peaked roof even this elevator could not be made to reach the ninth floor, so that a platform large enough for one buggy was constructed on top of it and while the floor of the elevator stopped at the eighth, the solitary buggy (all there was room for between the steel beams) landed at the ninth. The concrete foreman was not pleased with the progress of pouring this floor, and said so in no uncertain terms.

Aside from the methods described above, concrete was placed in different parts of the work by means of barrows, hand buckets, and one might almost say, table spoons, so difficult of access were some of the corners. It was also conveyed by many methods such as being slung by derricks on gin wheels, carried by hand, etc., according to the exigencies of the moment.

Formwork

In connection with the formwork 3 inch x 4 inch rough spruce was used for jacks where necessary, and also beam supports and column stiffeners. 1¼ inch sheeting D.I.S., and 2E, was used as decking, and 2 inch x 6 inch rough for joisting between beams. In the reinforced concrete slabs, the beam bottoms were first slung in place and hung over the I beams by means of No. 6 wire. The second operation was to place the beam sides and on these joists were secured; then the joists were placed at about 2 ft. centres, and the decking laid. Owing to the fact that no two floors are alike in the building, it was impossible to use the same forms intact, all the column sides and beam sides and bottoms having to be re-made each time. In the court and driveway slabs, which are entirely of reinforced concrete, the 3 inch x 4 inch jacks, were used instead of the wire, the construction being similar in all other respects.

Masonry

The cut stone and random ashlar, or Scotch work, is of Montreal and Deschambault limestone. Owing to the limited space available at the site a storage yard with siding was secured from the C.P.R. in the lower part of the city, and the stone conveyed to the building only as it was required in the work. A hoarding of ten by ten timbers and two inch plank was erected all along St. Louis Street and used as a working platform. Above this, stagings were constructed, where required, by means of outriggers from the various openings. Four hand-power derricks, each of 1½ tons capacity were erected on the convention hall wing, and a five-ton power derrick with a 56 foot boom placed in the centre of the Vercheres section, where the heaviest of the stone work is to be found. This latter derrick was first rigged without stiff legs, one of the steel columns being used as a mast, but later when the steel structure had reached the full height, the derrick was raised above the roof level and the regular mast and stiff legs used. The double drum hoist operating this derrick was placed on the first floor slab and the leads run up through holes in the intervening slabs. For the service wing and such dormers as could be reached by the derrick booms, gin poles and A-frames were used, these being easy of erection and quickly moved as required to the various points of vantage.

The brick masonry, consisting of Scotch fire brick face and Citadel shale brick backing, was laid up in cement mortar with a Flemish bond on the face. This work presentd no particular difficulties during construction. The mortar was mixed in the basement in a small Smith concrete mixer and from there conveyed to the different floors in the elevator, being then tempered and distributed to the hod carriers. A small portion of red ochre and lamp black was used in order to bring the mortar as near as possible to the same color as the brick.

Roofing

The roofing, as mentioned earlier in the article, has as a base hy-rib metal lathing. This was secured to the jack rafters by means of a small metal clip which was clamped on the flange of the beam and extended up into the rib of the metal lath, a four inch nail being then driven through the rib and a hole in the clamp. This when buried in the cement composition secured the whole thoroughly. The roof fireproofing was composed of four cubic feet of fine screened sand to one bag of asbestos (about 50 lbs.) and one bag of cement. This was laid on to a depth of two inches on the top and three quarters of an inch on the underside of the hy-rib. As this composition had to be laid with the consistency of mortar, it was not handled in the same manner as the concrete, but the materials were conveyed to the upper floors and there mixed by hand. To lay this, screeds were ripped from 1 1/8 inch material and securely wired on the hy-rib, the mixture then being laid on, smoothed with a zinc covered straight-edge and lightly trowelled. The laying of the composition was started from the ridge and worked downward, the screeds being removed as the work progressed. when it had become sufficiently set, which usually occured in about twelve hours, nailing strips of 2 x 3 were laid at 30 inch centres and bolted through with 3/8 inch bolts. On these nailing strips the 1¼ inch T & G sheathing was laid and securely nailed, and finally the ready roofing and copper were placed.

General Conditions and Plant

Wherever possible air was used on the work, a central plant consisting of a 50 h.p., 550 volt, C.G.E. motor and an Ingersoll-Rand 10 x 12 air compressor and storage tank, being located in what was formerly the main entrance arch. Supply pipes graded from three inch to one inch were distributed from this plant to the various parts of the buildings. The Ingersoll-Rand jackhamers and the rivetting guns were supplied with power from this source, as also were the stonecutters' hammers used for tooling, carving, cutting of raggles, etc. During the summer months when steam was not required the Smith concrete mixers were also run by air. For the power derricks, concrete hoists and material towers, one Beatty and one Marsh & Henthorn double drum hoist, were used. In addition a skeleton three drum machine was used in the rock excavation with a three ton derrick. Several separate boilers were kept on hand and put in commission as required for the heating of materials in the winter months, and generally supplying steam where required.

In the carpentry work, such as forms and rough framing, and the hundred and one jobs of ripping which crop up on a job of this kind, a 14 inch portable circular saw was employed. This was belt driven from a 550 volt, 5 h.p., C. G. E. motor, the whole beng self contained, and easily transferable to points of vantage.

The labor conditions throughout the work have been excellent, and aside from some minor differences no trouble of any kind has been experienced. No doubt this is due in considerable measure to the scarcity of work at the present time but credit must also be given to the natural contentedness of the average Quebec worker, and his desire to give value to the best of his ability for the remuneration received.

Personnel

The general contractors for this work are Anglin-Norcross Limited, 65 Victoria Street, Montreal, and the contractors for the structural steel, the Dominion Bridge Company. The roofing and sheet metal work is being carried out by MacFarlane-Douglas Co., of Ottawa; the plumbing, heating and electric wiring by the Mechanical Department of the C.P.R; the window frames are being manufactured by Jas. Davidsons' Sons of Ottawa, Douglas Bros., Architectural Bronze and Iron Works, Toronto, and the glazing is being done by Gauthier et Freres of Quebec; the stonework was cut and supplied by the Morrison Quarry Co., and the Quinlan Cut Stone Co.; the face brick came from The Heathfield Kilns; and the interior brick and terra cotta was manufactured by the Citadel Brick Co., of Quebec. The U. S. Steel Co., supplied the mesh reinforcement for floor slabs. The beam, column and slab reinforcing bars for the des Carrieres St. slab and the service wing ground floor were furnished by the Trussed Concrete Steel Co. The reinforçing steel (plain round bars) for the court was furnished by the Steel Co., of Canada.

The architects for this building are Messrs. E. & W. S. Maxwell of Montreal.

Rapid Building Construction

Builders are always interested in the rapid execution of a contract and a record seems to have been made recently in the erection of the twelve-storey office building of the Citizens Trust Company, at Terra Haute, Indiana. The erection of the structural steel frame seems to have been responsible, in a large degree, for the record being established. When it is stated that a two-storey structure occupied the site till February 1st., and that the steel frame was completed on May 1st., the remarkable speed of erection attainable in this type of construction should be clearly demonstrated.

Not only will builders be interested in this record but owners and prospective owners will doubtless realize the significance of this performance, for the sooner the building is completed, the sooner the floor-space is rented and a return on the money invested is secured.

This entire building operation was completed in 294 days, including Sundays and holidays, and in this time the buildings on the site were demolished, excavation done, the proper foundations for the heavy structure placed, and the entire superstructure erected; besides, the bank proper had all its equipment installed including vaults, decorations and furnishings. All the offices on the upper floors were also in completed condition on that date.

The framework of the building is composed of structural steel enclosed with brick walls, the exterior being faced with dark red pressed brick, with base of limestone. The cornice is of ornamental terra cotta. The office part of the building is built as a sort of a tower so as to provide permanent air and light at the rear. The lower floor, as well as the front and rear mezzanines, is occupied by a bank. The bank and offices are reached through a common entrance.

The building is equipped with two speedy elevators with an automatic device which ensures cars being brought to a stop at level of floor. There is a visitors' promenade around the roof, from which an extensive view of the surrounding country can be obtained.

Unique Church in Victoria, B. C.

What is reported to be the first church built in Canada for the exclusive use of the Chinese people has just been completed in Victoria, B. C., at the corner of Blanchard and North Park Streets. The building, which is of frame construction, with concrete pedestal foundations, includes, besides the main auditorium which has seating capacity of three hundred, a completely equipped kindergarten with two class rooms, with cloak room and vestry, which complete the accommodation on the main floor of the building. Underneath the school rooms is a large and lofty basement, which has been well finished and is to be equipped as a gymnasium.

The architect and builder, Mr. Wm. Hood, late of Port Arthur, Ont., and now of Victoria, has exercised a great deal of ingenuity in planning the building so as to make the space available for a variety of uses, and has succeeded admirably in spite of the handicap of a somewhat constricted building area, which necessitated a narrow frontage. The question of funds also was a serious limitation and the building is certainly an excellent example of what can be done with less than $6,000.00.

One of the simple yet efficient features of the building is the arrangement of the stage or rostrum, which is fitted with folding doors at the back, opening on to the main schoolroom behind, the floor of which is at the same level as the rostrum. This allows of practically doubling the auditorium capacity on occasion.

On the proposed Gerrard St. bridge project, at Toronto, three tenders were received, all being below the estimated cost of this structure. The three figures tendered were $721,519.88, $739,272.60 and $743,781.22.

Cost of the Johnson St. Bridge, Victoria

F. M. Preston, City Engineer of Victoria, Gives Some Figures Explaining the Increase in Cost Over the Original Estimate —Vindicates Day Labor

In our issue of May 10 there was an article entitled "Revision of the Cost Estimates of the Johnson St. Bridge, Victoria". The city engineer of Victoria, Mr. F. M. Preston, writes us regarding certain statements which he claims are in error. We have pleasure in giving Mr. Preston's explanations the same prominence as was given to the original article. Mr. Preston's statement follows:—

"In your issue of May 10th, there appears an article by J. B. Holdcroft, entitled, "Revision of the Cost Estimates of the Johnson Street Bridge, Victoria," to portions of which I take great exception, especially to the part of it concerned with the day labor methods used.

"I take no exception at all to that part of the article concerned with the 15% increase in costs over the original estimate, since this original estimate was made in 1919 upon only a general sketch plan and nothing was known as to the type of bascule, number of spans, or of the form which the substructure would take.

"After this estimate was prepared a railway loading was added to the city's side of the bridge, and therefore the Strauss Bascule Bridge Company's preliminary estimates were naturally affected; they were not asked for fresh estimates and therefore an unnecessary slur is cast upon the Strauss Bascule Bridge Company which should also be adequately corrected.

"The by-law for the additional $110,000 required has just been passed by the ratepayers by a very large majority, and this will give you some idea as to the 'feeling of consternation' which your correspondent says was produced. It was not known for certain until this year that the by-law amount would be exceeded.

"Referring to the part headed "Disadvantages of Handling Work by Day Labor," the following are the actual figures, and which can be verified without any difficulty.

"The original estimate for the whole of the substructure was $170,950, but when the final design was prepared, the cost was re-established at $212,500. For construction reasons the work had to be carried out in two portions, and the first portion, which has now been completed, consisted of the whole of the west abutment, the whole of the rest pier, two thirds of the main trunnion pier, about half of the east abutment and the whole of the counterweight trunnion pier. The cost of the first portion was estimated at $177,500 and the final portion at $35,000.

"Tenders were called in 1920 for the first portion of the work, and all tenders received, including an estimate made by the city engineer for carrying out the work by day labor, were based upon a schedule of quantities and prices; that is, the contractor was to be finally paid for the actual work done at the various prices submitted. No tenders on a lump sum basis were received. Taking the quantities given on this schedule, the city engineer's estimate for day labor worked out at $177,376, and that of the lowest contractor $212,714.

"After a final reckoning of quantities, the cost of the work, if it had been carried out by the contractor would have amounted to $239,766, and the actual day labor cost was $206,086, (this item of course, including all plant and equipment rental)—a direct saving of $33,680, by day labor, over the lowest contract tender.

"Taking each item of the work separately, the east abutment was constructed by day labor at a cost of $17,611 and the contractor's price would have been $19,783. The counterweight trunnion pier cost $68,225 and the contractor's price would have been $70,926. The main trunnion pier cost $43,616 and the contractor's price would have been $46,171. The rest pier cost $48,285 and the contractor's price would have been $63,763. The abutment cost $28,348 and the contractor's price would have been $39,123.

"Reverting to the question of the 15% excess cost of finished work over the original by-law estimate: I personally consider the original amount was a good guess—no one could call it an estimate—and I quote the following statement made to the city council on the subject: 'In order to give the city council some idea of the difficulties entailed in estimating bridge work, even only a few weeks ahead, (and not as had to be done with the by-law,—some years in advance of the work) I should like to point out that there was a range in prices in contract No. 1 of $80,000 for work costing in the neighborhood of $206,000; in contract No. 2, $78,000, in work costing approximately $239,000 and contract No. 3, in tenders refused a few weeks ago, approximately $41,000 upon work costing approximately $210,000. The above differences represent a percentage themselves of 30%, and assuming that the whole bridge will be completed for $840,000 the work will have been estimated originally within 16½%, which is a better guess for work to be done three years ahead than that made by the three largest bridge contractors in Canada, for work to be done a few months ahead.

"Referring to the paragraph "Expert Supervision Desirable," probably Mr. Holdcroft did not know that all the bridge plans had to be approved of by the C.P.R. bridge engineering department."

A catalog of Barford & Perkins, Ltd., of Peterborough, Eng., illustrating and describing their gasoline rollers, has been placed in our hands by E. O. Herbert, 81 Walnut St., Winnipeg, who is representing this firm in Canada. Two of the Barford & Perkins rollers have just been supplied to the Canadian National Parks. Mr. Herbert also handles in Canada the Ransome steam wagon, manufactured by Ransomes, Sims & Jefferies, Ltd., Ipswich, Eng.

About one hundred and ten union carpenters employed by the larger contractors in Toronto went on strike on May 29 owing to the employers having decided not to pay more than 80 cents per hour to the men. Officials of the union declare the prevailing rate is 90 cents per hour.

Repairing Subaqueous Water Mains

The Submarine Torch Facilitates Underwater Operations on Metal Conduits—A Difficult Repair Job Described to Indicate the Usefulness of the Device

Underwater operations, such as the repair of subaqueous water mains or other conduits, have always presented serious difficulties and hazards to the contractor. Recently, however, such work has been facilitated by the invention of the submarine torch which can now rapidly cut iron and steel structural materials when submerged to any depth within the physical limits of the diver. Inasmuch as this torch will henceforth have a wide field of usefulness the following record of its use in connection with a New York submerged water pipe is interesting. The description is by R. G. Skerrett in "Compressed Air."

Six years ago, Staten Island, i. e., the Borough of Richmond of the City of New York, was linked with the Catskill Water Supply System by a submarine pipe laid under the bed of the Narrows and connecting with a distributing main on the Brooklyn shore of the harbor. Thus, Silver Lake Reservoir was joined with the watershed 120 miles away and provision made for the continual storage of about 435,000,000 gallons of potable water.

The emplacement of the so-called "Narrows Siphon" represented an engineering achievement of a novel and a noteworthy character. The 10,000-foot span of that conduit consists of units of cast-iron pipe each twelve feet in length, 36 inches in diameter, and generally one and five-eighths inches thick. Section by section the conduit was assembled on a curved skidway of steel framing and allowed to slide into a trench, excavated in the harbor bottom, as the conduit lengthened and the skidway was dragged forward by an associate floating derrick.

Assembling the Pipe

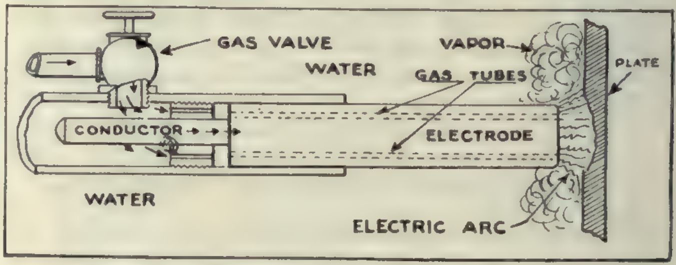
This procedure required that the pipe joints be flexible to facilitate assembling and the subsequent planting along the line chosen. It was equally essential that these unique joints should be tight after the conduit settled into its permanent position; and to this end an ingenious type of lead packing was devised, the last of which was forced in place by means of compressed air. Each pipe unit was formed with a bell-shaped flare at one end, the lip of which was reinforced by a tire or band of wrought iron, and at the spigot or smaller end there were several annular ridges to assist in anchoring the metal packing interposed there between the spigot and the bell of the succeeding overlapping pipe section.

Before a length of pipe was sumerged, the newly-made joint was deliberately deflected five degrees and tested under a hydrostatic pressure of 100 pounds per suqare inch. If this test was satisfactory, then that unit of the conduit was launched from the scow and allowed to sink below the harbor's surface. These details are mentioned here to show the care and the steps taken in assembling and in laying the Narrows Siphon in order that the reader may realize the limitations and the difficulties entailed in making repairs calling for the replacement of a damaged pipe section.

On February 2nd, a large dredge, operating in the slip where the submarine main is buried close to the Staten Island shore, accidently dropped a great anchoring spud down on to one of the pipe lengths. Despite the fact that the blow of this descending spar was tempered by the penetration of 23 feet of mud, still the impact was sufficient to open up a wide longitudinal fracture a number of feet long. Instantly a geyser of water shot upwards under a head of more than 200 feet; and with all possible dispatch the valves at both ends of the siphon were closed for the double purpose of shutting off the supply at the Brooklyn end and to prevent the backward flow of water from Silver Lake. Staten Island was thus isolated from the Catskill aqueduce, and its citizens compelled to rely upon the water stored in the local reservoir.

Problems Involved in the Repair

The situation called for all practicable speed in effecting the insertion of a new section; and it was equally important that none of the neighboring sound units of the conduit be wrecked or disturbed lest their joints be injured thereby. Here was a problem that called for unusual treatment and the nicest kind of handling; and the same firm of salvage engineers, the Merritt & Chapman Derrick & Wrecking Company, that laid the siphon originally undertook the repair work. The primary question was how to withdraw the ruptured length? Even before this could be essayed two things had to be done: first, the position of the break had to be determined accurately; and next, a large area of overlying and enveloping mud had to be cleared away so that the divers could reach their goal and work without risk of having the harbor bed slide in on them.

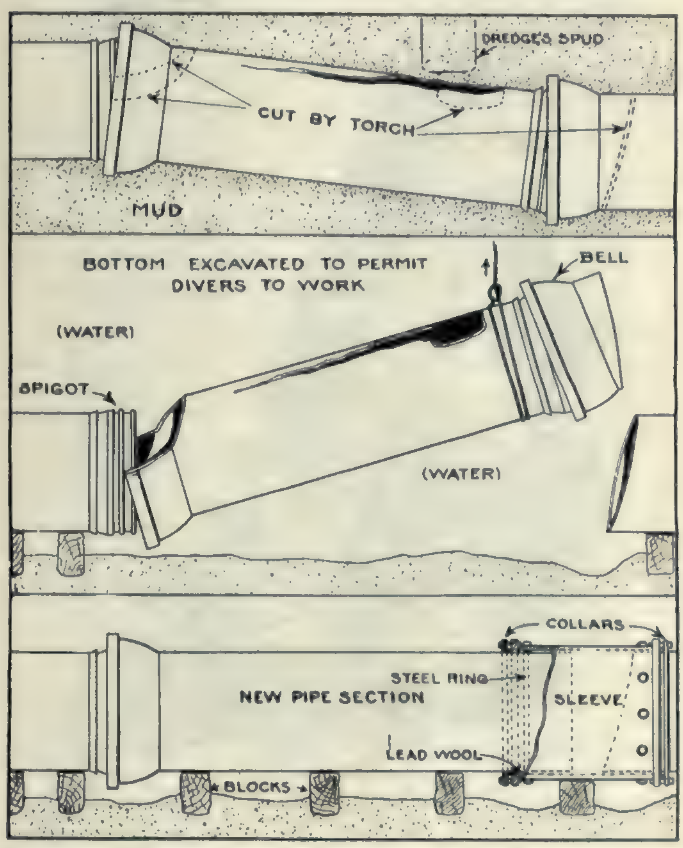


Cross section of the gas-electric submarine torch

A short distance from the head of the slip is a hydrant, connected with the main, standing between a cut-off valve and the sea wall, and to this hydrant was attached an air pipe leading from a powerful compressor aboard one of the assembled flotilla of wrecking craft. When air was blown into the hydrant, and thence into the main, its only avenue of escape was down and outward toward the fractured section. On reaching the hole there the air was free to mount to the surface of the water and thus to indicate approximately the location of the trouble. Later on, compressed air was similarly employed to guide the divers to their tasks.

The bed of mud about the operating zone was removed by dredging and by suction pumps, and the mud immediately beneath the main was loosened up and driven out by high-pressure water jets. In this way a large crater with gently sloping sides was formed and the divers safe-guarded against a cave-in. These preparations disclosed that the damaging blow had forced downward and out of line some of the pipe lengths adjoining the broken one, and a wrecking derrick was used to raise and to restore them to alignment while the divers blocked them up from beneath. Now for the more spectacular aspect of the job.

The reports of the divers made it clear that the withdrawal of the injured section could best be accomplished by severing the bell of a joining section, just to the rear of that flare, and by cutting away the bigger part of the upper half of the smashed unit's own bell. In this was the ruptured pipe could be lifted and detached easily. To carry out this plan the salvors decided to utilize the Chapman-Kirk submarine torch perfected by one of its own experts, Ralph E. Chapman. This patented torch is the result of over three years of developmental work, in which Mr. J. R. Jenkins, the company's chief electrician, has lent valuable aid.



The various stages leading to the repair of the injured water main

The Torch

In its initial form the torch consisted of an oxy-acetylene flame and an electric arc, and could be ignited under water. Further developments followed—indeed, these have been essential so as to deal with the job on the Narrows Siphon.

While the melting point of cast iron is about 2,200 degrees Fahrenheit, remelting calls for a much higher temperature, something like 3,000 degrees Fahrenheit. Therefore, the cutting of the heavy walls of the Staten Island submerged conduit presented a more difficult problem than any previously attacked. During a series of tests, preparatory to dealing with that task, it was proved conclusively that oxy-acetylene gas would not answer, especially at the depth required, where the pressure of the combustible would have to be 30 pounds or more. Acetylene at that pressure, instead of flaming in the desired manner, is apt to explode and to backfire up the pipe, bursting the latter if it does no greater damage.

True, the oxy-acetylene flame has a temperature of 3,600 degrees Fahrenheit when combustion is perfect, but under water the gas has a two-fold function to perform; first, that of holding the surrounding water at bay by reason of its expulsive force exerted within a cup-like nozzle, and, next, that of melting the metal exposed to the flame. Therefore, the repelling impulse must more than counterbalance the hydrostatic head of the enveloping water; and when the flame is not at its normal intensity its heat is too quickly dissipated to enable the torch to cut through fairly thick barriers of metal—especially such a metal as cast iron.

The torch recently employed does not rely upon oxy-acetylene, but uses another cutting gas, and this is brought into play in combination with an electric arc. The gas is drawn from flasks charged under high pressure. The inflamed gas—exerting a disruptive force by reason of its expansion due to heat and its exhaust pressure—converts the surrounding water into steam, and in the midst of this vaporous envelope the incandescent arc comes into action automatically. That is to say, the diver, by holding his torch within a quarter of an inch of the metal to be attacked, induces an arc across the gap; and so long as he maintains this distance, and current is fed through the attached conductor, the electricity flows to the neighboring "ground."

The temperature of the arc is about 6,700 degrees Fahrenheit; and this intense heat has made it possible to cut through the one and five-eighths inch wall of the conduit at a linear rate of from four to six inches per hour. This speed varies with the ease with which the diver can reach his objective. Wrought-iron or steel plating one-half inch thick can be cut at the rate of twenty inches per hour.

Repair Methods

And now let us see what was done by the divers who worked night and day so that the people of Staten Island could again have their regular supply of mountain water before the reserve in Silver Lake reservoir was exhausted. At the start, the divers enlarged a section of the break on top of the damaged pipe sufficiently to form a hatchway, through which a single diver culd enter for purpose of severing the bottom third of one bell which was not accessible from the outside. The remaining two-thirds was cut from the exterior. A large upper sector of the bell at the opposite end of the injured unit was also cut away from without. Before this latter operation was started, the shrunk-on wrought-iron ring around the lip of this bell was detached by cutting it through at two points. This reinforcing band was an inch and a half thick and four inches wide.

When all of the cutting was finished, the slope of the circumferential cleverage allowed the pipe there to be raised right up with the result that the lead-packed joint at the other end parted without violence so that the freed section could be brought to the surface. The replacing unit was next lowered; shifted into its proper position; secured at the bell end by gib screws; and the joint packed tight with lead wool by pneumatic hammers. Because of the removal of the bell from the sound section, as previously described, there remained a gap of about ten inches between it and the spigot of the new pipe length. To bridge this a cast-steel sleeve five feet long, one and five eighths inches thick with an internal clearance of an inch and a half, was shoved onto the replacement unit before the latter was lowered overboard. This sleeve was then shifted until it embraced equally the opposing pipe ends. It was then anchored by gib screws to each of the neighboring lengths.

The two joints thus formed were sealed in the following fashion; at each of them was inserted a split band of steel, two inches wide which was seated against the inner projections of the gib screws, and next, the remaining space, three inches deep, was packed pueumatically with lead wool. Terminal rings of cast-steel, drawn snugly against the sleeve by screw bolts, completed these joints and served to block any tendency of the metal packing to work outward.

During their operations under water, outside of the injured section, the divers used a wooden template—consisting of a central stick carrying a number of two-foot cross-pieces spaced twelve inches apart. This enables them to determine and to report accurately the dimensions, the position, and the exact shape of the break. Even in muddy water, such as they had to content with, the glare of the arc is rather dazzling, and although the divers tried colored glasses to protect their eyes these were not satisfactory inasmuch as they turned the feeble natural light into inky blackness the moment the arc was extinguished. This difficulty may, perhaps, be overcome by devising a screen, attached outside of the helmet, which the diver can adjust at will.

Protection From Accident

The under-water toilers are safeguarded from any untoward accidents due to their torches by shutting off the electric current while the men are approaching and leaving their subaqueous objectives. It is important that they handle their torches carefully, however, when ascending and descending, because the terminal electrodes are rather delicate; and substituting a new torch for a broken one takes time. A carbon electrode is consumed in about twenty minutes, so intense is the heat of the arc. The evolution of this apparatus and its performances indicate wide fields of service for it in the future; and this ingenious agency promises to expedite the execution of tasks under water that otherwise might be difficult if not impracticable.

When the iphon was ruptured, mud and foul water from The Narrows entered the main, and the responsible city officials recognized that the conduit should not be put in service again until it had been thoroughly purged. To effect this, after all repairs were made, the gate valve at the Brooklyn end of the line was opened, while at the Staten Island terminal the siphon was bi-passed into a neighboring sewer through a twelve-inch blow-off connection. Then, large quantities of liquid chlorine were introduced at the Brooklyn end to insure thorough sterilizing. Only after a series of tests showing the water to be in a proper state was the blow-off closed, the Staten Island gate valve opened, and the restored flow permitted to mount thence to Silver Lake reservoir.

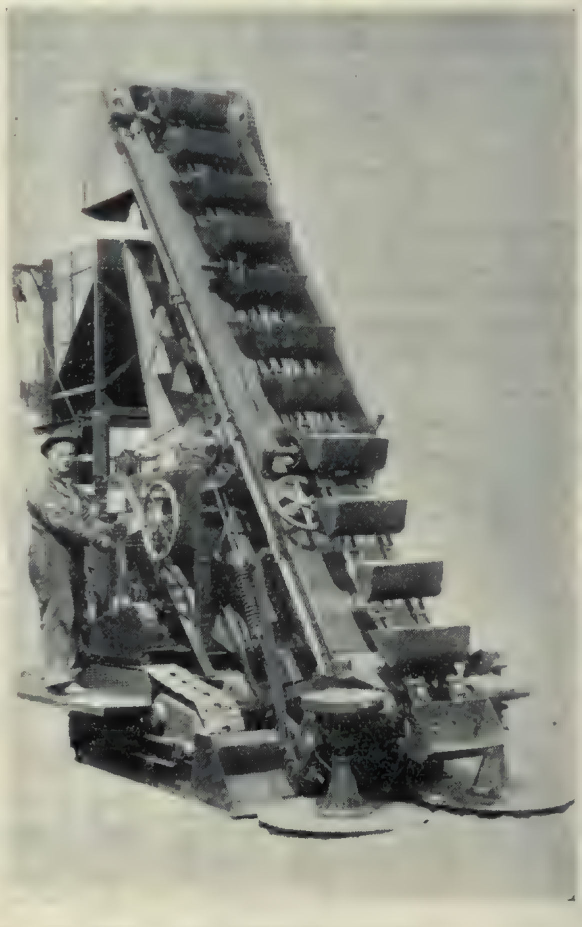
Barber-Greene Co. Announce New Loader

A bigger and better self-feeding bucket loader is announced by Barber-Greene Company. Capacity has been increased from 1¼ cubic yards per minute to 1¾ cubic yards per minute. The crawlers are now 10" wide instead of 8", and 60" long instead of 58". A new Buda engine, equipped with oil and water pumps, furnishes ready power.

The same disc feeder which distinguished the first Barber-Greene is used on this new Model 42. This feeder consists of two 36" flat steel discs placed in a horizontal plane at the lower end of the boom and driven by gears so that they both turn towards the center and thus bring material to the buckets. A better arrangement for controlling the disc is provided.

A measuring hopper with a variable capacity up to 21 cubic feet can be furnshed for use of road contractors, although standard equipment is a swivel spout which can be turned from the operator's platform. Discharge height is 9' 6".

Another new feature is the adoption of the standard Cotta truck transmission, giving 3 speeds forward and one reverse, as well as the dependability of the Cotta standard truck transmission.


New Barber-Green Loader

This machine can be used to load trucks, wagons, cars or conveyors with any bulk material such as coal, coke, sand, gravel or crushed rock with one man at the rate of 1¾ yards per minute.

This machine is handled in Canada by Mussens Ltd.

Bill Licensing Ontario Engineers

The bill to incorporate an Association of Professional Engineers in Ontario passed finally through Committee of the Whole House in the Legislature on May 30. The words "professional engineer," where they occurred in the original act, are to be changed to "members of the association." Various other minor amendments were adopted. These changes, together with amendments accepted previously, while they leave a bill that permits the establishment of an association of Professional Engineers, tkae out to a great extent the penalty clauses against those persons who follow the calling though not members of the association.

What's the Cause of Unemployment in the Construction Industry?

Inefficient Management is a Tangible Producer of Unemployment—The Effect of Bad Weather and Off-Seasons is Over-rated

By A. P. GREENSFELDER
Before the National Federation of Construction Industries

One of the most costly and serious problems of our whole constructon industry is due to unemployment—both of capital and labor. We are apt to think of idleness only in terms of man power, but as capital can only produce and wealth increase by the application of that man power, it behooves us to realize that their interests are common. We must further remember that unless the laborer earns, he has but little to spend; and his demands for goods and shelter are what produce the insistence for the supply which capital helps create.

The construction industry of all our industries next to agriculture, has possibly the least concerned and yet the most affected by unemployment. We seem, until quite recently perhaps, to have taken it for granted that because field construction is largely conducted out of doors, it must necessarily be governed by the weather and conditions incident thereto. Summer sunshine has been and still is overcapitalized. Because field construction seldom has a roof over its factory we fail to view it as a producing factor of the same potentiality to equal capital invested within an inclosure.

When a construction project is idle for any cause the invested capital is idle, the allotted workers are unemployed and the producers and conveyors of construction materials are seriously interrupted. The total cost of this unemployment is a vast sum unnecessarily added as a wasteful annual expense to the whole industry and each integral part. A valuable attempt to measure such waste in the building industry is noted in the study initiated by Secretary Hoover, through American Engineering Council last year. Sanford E. Thompson, consulting engineer of Boston, who applied the principles of industrial waste to the building business, in such printed report calls particular attention to this irregular employment and the expenses caused thereby. He states that due to an average of only 190 working days a year for field construction the loss to the United States from this cause alone is approximately $100,000,000 annually. If we add to this the interest during construction, the idle labor, material and transportation facilities of dependent quarries, mills, shops and ways, the total loss is enormous.

Can the construction industry be so blind to its own self interest as well as its duty to the nation not to realize the necessity of reducing this burden? Cannot brick makers, steel producers, railroad men, designers, contractors and laborers realize that continuous employment means better annual earnings and yet cheaper production. Cheaper prices mean greater demand and this in turn provides continuous employment. Reduced costs per cubic foot of structures, be they stores, schools or houses, means increased volume of demand. Homes at $1,000 per room will create more than twice the demand than will the same values at 50 per cent. increased cost.

Causes and Remedies

Having diagnosed the disease and the public burden thereof, let us study the causes and endeavor to provide possible remedies. The principal causes are (1) seasonal fluctuations, (2) bad weather, (3) labor strikes and lock-outs, (4) inefficient management and (5) restricted production. Careful analysis of each of such causes, resolute endeavors to correct them and an earnest spirit of co-operation will gradually produce results. Some results of large measure can undoubtedly be secured within one year and others will rapidly follow as the movement progresses. Seasonal fluctuations are largely because of old fashioned customs. Before the days of mechanical field equipment construction progress throughout the year was seldom contemplated. Today such reasons do not control. Land values and production demands for floor space now outweigh minor variations in seasonal costs and a proper educational campaign through concerted nationally-directed advertising can do wonders. A "Plan Early" crusade can be made equally effective as a "Winter-let Contract" by proper inducements of seasonal discounts in material prices freight rates, wages, and the superimposed planning supervising and financial commissions.

Bad Weather a Relative Condition

Bad weather is purely a relative condition and much good can be mixed with it. Ordinary winter temperatures can be easily moderated by the judicious application of heat, and wind, snow and rain can be excluded by canvas and common sense. If $1,500 is a fair annual wage for skilled labor this may be earned at the rate of $7.50 per day for 200 working days or at $5.00 daily for 300 days. Henry Ford has thoroughly demonstrated that the latter rate is sufficient, highly profitable to himself and tremendously useful to the public. Competent labor can be attracted to low turn-over industries when fairly paid and cared for. Bricks, steel and lumber do not freeze—only fingers and mortar for an average of 20 daye and the cost of applying gloves and anti-freezing remedies is relatively small in moct latitudes as compared to the "unearned increment" lost in waiting. The cold weather differential is only a few per cent. and can be readily off-set by reduced prices or one-half hour longer labor per day for winter months.

Strikes and Lockouts Need Sunlight

Labor strikes and lock-outs are human factors needing the sunlight of broad self interest, food of facts and careful competent and co-operative nursing to cure them of their cancers. The National Board for Jurisdictional Awards in the Building Industry, is evidence of possibilities and practical results in eliminating strikes. Industrial labor boards in factory, field and nation can largely reduce unemployment due to labor disputes. Employers and employees should jointly study the labor problems and their true relationship if we are to progress in skill, safety and satisfaction in this industry. The public is learning that it pays "the bill of costs" for every effective "bill of rights," and as soon as it obtains the correct figures it is beginning to demand, each industry either must arbitrate all its labor differences or it will be done for them in legalized industrial courts. Let us lead the way, and raise facts instead of factions in the construction industry.

Inefficiency Produces Unemployment

Inefficient management is a real tangible producer of unemployment and is a man-sized job to tackle. Production analysis may be a new term to the construction industry, but it is a vital element in the elimination of waste. Production schedules planning, routing and expediting materials so as to avoid delays and shut-downs are real responsibilities of managers. Proper maintenance of plant and machinery not only prevents breakdowns and labor lay-offs, but pays dividends well worth the earning. Employment managers must be made if they can not be found, because labor turnover rates in the industry are a disgrace not only due to the previous causes, but due to the irate desire of pin-headed bosses to exercise and show their authority. Transferring men to the right jobs is better than firing, and nothing is quite as needless and expensive as training and hiring. Let us determine a fair day's work for a fair workman and a fair day's pay will soon take care of itself.

Restricted Production Influenced by Fear

Restricted production is largely the result of unenlightened labor. Discouraging experiences of piece work, price reductions and replacement by machinery without consideration of the employee have undoubtedly had their effect on labor in its attempt to avoid unemployment by restricting production. Discouragement of apprentices, restricting output of skilled men and reducing dilution by unskilled labor all have been influenced by the dread and fear of unemployment. Organizations of labor are perhaps more often formed to combat such practices than to protect themselves against wage reductions, but that they have gone to the other extremes in many cases, especially in the last few years, is needless to say. Vocational training simultaneous with apprenticeship. profit sharing, insurance for accident, illness, unemployment and old age are possibly measures for investigation in order to remove the fear of hunger and instill a recognition of real pride and craftsmanship both in quantity and quality production.

Eliminating Cement Sack Losses

Loss of Containers is an Important Cost Item of Concrete Work—Care and Return of Empty Bags—Low Sack Return From Small-Lot Sales

By WARD P. CHRISTIE
Research Engineer, Associated General Contractors of America
In the A.G.C.'s official publication

The loss of cement sacks on a construction project is generally recognized by contractors as an important cost item of the concrete work, but it is frequently regarded by others as a result of carelessness which should be eliminated. While wide variation from average loss might be charged to improper handling, all cement sacks have a limited life, at the end of which construction must pay over to the cement industry an amount for each sack lost or made unserviceable. To ascertain this average loss and to throw some light upon the allowance which should be made in a construction estimate to cover its expense, the Research Department of the Associated General Contractors has obtained data on the subject from the records of cement manufacturers. These records, which have been carefully kept over a period of years enable approximate determination of the following items.

1. Average number of sacks lost or destroyed.
2. Average number returned but rejected at the mills.
3. Average number of trips per sack.

From the record of the number of sacks lost or destroyed and the number rejected at the mills is deduced the average number of trips per sack. This deduction is based upon the average replacement required. Thus if eight per cent of the sacks sent out over such a period are not returned and if two per cent are rejected at the mills the average replacement is ten per cent and the average indicated number of trips per sack is ten.

Small Lot Sales Show Low Sack Return

Records from the different companies show no great variation over a long period, though obviously the return from individual sales does vary within wide limits. On small-lot sales, which constitute some fifty per cent or more of all sales, the return of sacks is low. A farmer buying three sacks of cement for the foundation of his hen house often finds good use for the sacks and does not return them, whereas, an efficient road building plant may succeed in effecting almost a perfect return. Between these extremes is room for great variation, but, speaking for major construction projects, where a maximum return of sacks occurs the variation is within much narrower limits.

The percentage of sacks rejected also shows but slight variation, though some variation is due to the personal judgment of the inspectors, who allow greater or less latitude at different times. Sacks are rejected on account of unsatisfactory condition caused by ordinary wear and tear, setting of cement in the fabric, and tearing. A clean tear or rip, however, is usually accepted. Of all sacks rejected those that have become wet constitute by far the greatest number.

Records From Cement Companies

Records of the Vulcanite Portland Cement Company, kept since 1903, show an average return of 89 or 90 per cent, but in recent years this average has dropped to about 85 per cent. In addition to the 15 per cent. thus lost in the field, approximately two per cent. are rejected by inspectors. Thus the amount lost, destroyed and rejected, for which contractors must pay, according to this company's records, is about 17 per cent. This indicates an average of six trips per sack.

Records of the Lehigh Portland Cement Company over a seven year period show an average loss of between 14 and 17 per cent., or an average of between six and seven trips.

The Universal Portland Cement Company's records show the highest return noted, which averaged 90 per cent., or ten trips per sack. This high rate is attributed by the company principally to its educational campaign among cement users, who have been supplied with information relative to the best method of handling sacks, and preparing them for shipment.

During 1920 the records of the Canada Cement Company showed that their sacks averaged 2½ trips per year and that the average life was 6.8 trips. Other companies, who requested that their names be withheld, show a total return of sacks varying from 80 to 90 per cent., or a variation between 5 and 10 trips per sack.

Care and Return of Empty Sacks

In order to spread information as to the proper care of cement sacks and to insure the return of as large a proportion of them as possible, instructions similar to that printed below, are sent out to users of Universal cement. Compliance with these instructions, it is believed, has helped to reduce materially the loss and damage of sacks.

Rules to be Observed by Men Handling Sacks

I. Value of Cloth Sacks

1. A carload of sacks is worth several carloads of cement.

2. Gross price of Universal cement packed in cloth sacks includes charge for sacks, which remain Universal property and are leased to purchasers of cement. Sack charge is refunded in full to original purchasers of cement for such returned empty sacks as are in good or repairable condition when received at Universal's plants.

3. Storing large numbers of empty sacks ties up money that earns no dividends.

II. Parties Involved

1. Railroads handle hundreds of carloads of sacks. They cannot be expected to have the same interest in one bundle as a shipper.

2. Manufacturer handles millions of sacks a year. He is anxious to give prompt credit.

3. Shipper can reduce tedious delays to a minimum by observing rules of railroad and following suggestions of manufacturers.

III. Railroad Rules Specify That

1. Bundles must be tied with three separate wires or ropes. (If rope is used it must be not less than 3/16 inch in diameter.)

2. Freight must be prepaid to destination.

Note. Placards for placing in warehouse contain summary of railroad's rules and manufacturer's recommendations. If your copy is mislaid, write for another.

IV. Tags

1. Must contain name and address of consignee.
2. Must contain name and address of shipper.
3. Must contain name and address of party to whom credit is to be issued.

V. Linen Tags Furnished by Universal

1. Front bears Universal's name and address and contains blanks for date of shipment and for shipper's and creditor's names and addresses.

2. Reverse side has blanks to show total number of bundles and sacks in shipment.

3. Complete filling out of blanks makes issuing of credit easy and simplifies sorting of thousands of individual shipments.

4. Every carload of Universal has ample supply of tags in "Loading Envelope."

5. More Universal tags will be sent on request.

VI. Credit

1. Bundles must be identified before credit can be issued.

2. Card, letterhead or extra filled out tag inside of bundle insures of identification even if outside tag be lost in handling, provided that bundle reaches destination intact.

3. Failure to send bill of lading delays credit, as shipment often is delivered before railroad furnishes proper billing.

4. Tags properly filled out on both sides show immediately; a. Number of sacks in shipment. b. Name of shipper. c. Party to be credited.

"Americans Deserve Business; They Advertise for it"

The Toronto Advertising Club held the final meeting of its season at the King Edward Hotel, May 11. Although the attendence was small, considerable interest and discussion was aroused by the address of Russell T. Kelley, of the Hamilton Advertisers' Agency, Ltd., the principal speaker of the evening, whose subject on "Advertising from a business man's standpoint" permitted a wide expression of opinion.

Mr. Kelley touched upon such matters as national unity, the development of Canadian exports, the establishment of industrial bureau to decentralize industry and build up smaller centres; but the larger portion of his talk, and most of the discussion which followed, centred about the extension of domestic trade in Canadian made goods. The speaker referred to the large consumption here of a particular American soap, the popularity of American clothes, and to the fact that half a million dollars a day is being spent by Canadians in American resorts.

E. Sterling Dean, who was among others to comment on Mr. Kelley's remarks, stated emphatically that if American firms were getting a large share of Canadian business they were entitled to it. "They go after it;" he said, "they advertise for it; they get results. If the Canadian manufacturer really wants the business he can get it by advertising for it. Just to satisfy myself of the extent of American advertising in Canada," said Mr. Dean, "I recently checked over the national advertising in a Canadian publication and found that sixty per cent of it was American. This may not be a fair average for all publications, but it is an indication of the aggressiveness of U. S. firms in this country. Until our own manufacturers become equally aggressive the 'Made-in-Canada' cry will remain largely inoperative." —Marketing.

Frame Construction and Fire Hazard

The National Lumber Manufacturers' Association Quote Statistics to Show That Wood Is Not the Fire Menace That Is Generally Supposed

The National Lumber Manufacturers' Association in a recent issue of its "National Lumber Bulletin" quotes the following statistics to show that frame construction is not as fire hazardous as is often supposed.

Type of Building	Number of each type in 83 cities	Number of fires in each type in 1920
Reinforced Concrete	2,589	163
Fire Proof (Steel Frame)	3,421	92
Brick and Stone	283,432	6,877
Iron-Clad	2,809	136
Frame	944,494	15,637
Concrete Block	5,305	148
Buildings not classified	12,112	336
	1,254,192	23,389
Total building fires		23,389
Other than building fires		11,108
Total fires		34,497

The foregoing is one of a series of summaries being compiled by the Technical and Research Department of the National Lumber Manufacturers Association from figures appearing in the last annual report of the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters.

The above summary lists the number of buildings of various types in 83 cities of the United States of 20,000 population or more, for which the Board of Fire Underwriters could obtain the complete data. It also lists in these 83 cities the number of fires occurring in 1920 according to type of construction. The aggregate population of the 83 cities is more than five and three quarters millions.

Of the million and a quarter buildings enumerated, it will be noted that nearly a million, or 75.3%, were of frame construction.

In 1920 in these 83 cities there were

16.5 fires per 1,000 frame buildings.
24.3 fires per 1,000 brick and stone buildings.
25.0 fires per 1,000 buildings other than frame.

In other words, there were 2/3 as many fires per 1,000 frame buildings as per 1,000 buildings of other types, though the frame buildings in these cities outnumbered all other types more than 3 to 1:

Ratio of frame buildings to brick and stone, 3.33 to 1.
Ratio of frame buildings to all other than frame, 3.27 to 1.

The Technical and Research Department has made these computations from the Fire Underwriters' not to create the impression that frame construction is superior **to all other types for all purposes,** but to show, from unbiased official reports from a large number of good-sized representative cities, that frame construction is not the fire menace which the public has been led to believe.

Communicated Fires

As to communicated fires the "National Lumber Bulletin" has this to say:

It has been often stated that frame buildings and wooden shingle roofs are the principal cause of communicated fires, that communicated fires represent the major per cent. of annual fires and the losses from them the major per cent of the annual fire loss. Yet in 1920 in these same 83 cities 98.7% of all fires were confined to the building or place in which they originated. Communicated fires represent 1.3% of the total number of fires and only 1/5 of 1% of the total fires extending beyond the building immediately adjoining the place of origin.

In 1920 in these 83 cities, all fires caused total loss to buildings and contents of $23,707,411; communicated fires caused loss of $1,714,108 or 7.34 % of the total. No figures are available for the number of fires communicated to and from frame buildings, but it is well known that the majority of communicated fires and the greatest fire losses occur in business and mercantile districts where frame construction does not predominate.

Witness the recent fire in Chicago in which a sixteen-storey supposedly fire-proof building was reported as totally destroyed by a fire which was communicated to it from an adjoining building. The large area covered by this particular fire with an estimated $8,000,000 loss is a district in which there are no frame buildings and no wooden shingle roofs.

The number of communicated fires in comparison to total fires for five years for from 278 to 311 cities is shown in the following table compiled by the Technical and Research Department from reports of the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters:

			No. of fires extending to adjoining bldgs. only		No. of fires extending beyond adjoining bldgs.	
	Number cities Reporting	Total Number of Fires	Number	% of Total Fires	Number	% of Total Fires
1916	302	167,769	3,191	1.90	602	0.35
1917	293	149,951	2,776	1.85	699	0.46
1918	288	174,277	5,335	3.06	685	0.39
1919	278	156,633	2,613	1.66	705	0.45
1920	311	189,126	2,910	1.53	624	0.33

Nearly one-half of the communicated fires reported for 1918 (2,611 out of 5,335) occurred in Philadelphia. Yet in that city in 1918 **only 2.55 per cent of all buildings were of frame construction,** and only a slightly larger percentage were buildings covered with wooden shingle roofs. Moreover the communicated fires included some fires that did not have their origin in buildings (such as bonfires, explosions, etc.).

Reduction of Fire Losses

As far as reduction of fire losses is concerned it is clearly useless to replace wood with other materials. Attention should rather be given to ways of preventing hazardous occupancies and carelessness of occupants, and of providing common-sense fire protection. Attention to these matters will go further to reduce the great annual fire loss than the efforts of those who are making strenuous attempts to replace wood with their chosen material.

As the years pass the degree of carelessness of the occupants of buildings seems to increase in proportion to the added degree of fire protection. A residence built of materials that will not readily burn increases the occupant's negligence.

Standardization of Slate Products

Greater standardization of slate products for building purposes and the extension of the usefulness of the material were urged at a recent conference of slate producers by Victor D. Abel, of the Structural Service Bureau of Philadelphia. The title of his paper was "Reduction of Cost Through Simplification of Products" from which the following extracts are of special interest to the construction industry.

The main feature of standardization of sizes and types is in the opportunity to encourage continuous production. In other words, if the production of roofing and structural slate and, in the certain regions, blackboard slate, should be carried along at the same time, so as to divert into the proper channel for these uses that portion of the rock suitable for each use, there must be a sufficient standardization of sizes to use up all of the stone, as it is brought out of the hole.

In the study of sizes it was found possible to reduce greatly the various dimensions in number and to recommend the adoption of a simplified number of sizes and types of W. C. inclosures, urinals, shower stalls, etc., which would fully cover the various uses for which they would be required. This immediately reduced the number of kinds, so that they could be kept constantly in stock and it is quite possible for any erecting a building to take advantage of these uniform sizes and so construct the building as to receive them, when the designers realize the advantages of economy, delivery and installation gained.

When studying the installations themselves, such as in the W. C. inclosures, every part is considered, and it was found that, by changing the customary joint where the end and partition butt into the back, the parts and sizes could be simplified and the number of operations of production reduced. The result of this study of joining was that with one hundred and twenty combinations and sizes of types of W. C. inclosures, it was possible to produce these from only thirty-five different sizes of slabs. Think of the saving in output, storage, shipment and inspection.

Nearly all W. C. inclosures heretofore made have had the ends run into the back wall and the backs butt into them, making the ends one inch wider than the partitions. By butting the ends against the backs, this made both ends and partitions the same size, reducing thus the time of getting out two different sizes of slabs and storage, selection, packing and checking up their installation at the job. The same is true of the backs. By making the end enclosure one-half inch narrower than the center inclosure, it was found possible to make all back slabs exactly the same width, with the corresponding simplification of production and use.

Roofing

Turn to the subject of roofing. A complete study should be made of the sizes best adapted to all types of houses, and whether it is good construction to put the slate on single lath or whether it should be put on solid sheathing. Again, the architect today must give attention to the effect of light and shade, and he does not require that every piece of slate for the roof be exactly square. Just as in brick work, he has turned away from the old face brick to the more artistic, less expensive and far better looking, rough hard red brick with wide joints, so he would prefer to have a roof laid with irregular edges of slate. At present when a piece of slate does not cut to an exact oblong, it is thrown in the waste. Why not use this slate for inexpensive houses, where it would provide sufficient protection and really look better?

Use of Slate Waste

Then again, in the utilization of the waste, there are many possibilities for use as copings, sills and heads of windows, steps, walks and even for the walls of buildings. Again, slate is an excellent material for carving, and could be used as rough stone panels with carved letters.

These are but a few of the steps which can be pointed out to help in the wider use of slate, which after all is the only possible chance of a reduction in the cost within the building, and all architects must consider not the cost of the material itself, but its comparative cost after placed in the position it is to occupy in the type of building and in the use for which it is intended. That is the important thing and it is absolutely essential that in the encouragement of the greater use of slate, its intelligent use must be fostered, and specifications, details and instructions issued showing how it should be used so as to give its proper service.

Functions of Trade Associations

Very frequently there is much misconception regarding the functions of trade associations. In the minds of many people they are considered as organizations operating in the restraint of trade by fixing prices or eliminating competition. Associations with such motives have existed, no doubt, and have done much to prejudice people against trade organizations of any kind. However, there are associations—and many of them—which have been formed in response to definite needs—to promite more intelligent conduct of business or to increase the knowledge regarding and the usefulness of the products of the industry represented. These functions are entirely worthy and are calculated to increase public sentiment in favor of the industry by disseminating information of interest and educational value to people who use the products which that industry sells. An example of such a trade or industrial association is the Portland Cement Association, which is supported by manufacturers in Canada, the United States, Cuba, Mexico, Uruguay and Argentine. The character and purposes of this association are described briefly as follows by its president, L. T. Sunderland:

The Portland Cement Association, which originated in 1902, is not commercialized in the usual sense of the word, and is neither concerned in the direct sale and distribution of cement, nor in the trading relationships between its membership and their patrons.

Because of its simplicity of use, adaptability and enduring nature, probably no factory-made basic material occupies such a broad field of usefulness as does cement, or offers such promising opportunities for expansion of its uses. Recognition of these facts is primarily responsible for the existence of the Portland Cement Association.

Many products and processes of great benefit to humanidity have failed to achieve the full recobnition and use to which their worth entitled them, because accurate knowledge of their value and utility was not intelligently sought and widely disseminated. It is only in recent years, since advertising under the pressure of competition developed into true art, that producers have sought, by alliance of their forces, to effect a widespread knowledge of the utility of their products; and wherever the intrinsic value to mankind of the product has equalled the claims made for it, markets have expanded, production has increased, and a great service has been rendered the public.

The results already achieved by this Association indicate clearly the great opportunity to secure that substantial trade expansion which lies in unified effort in the research-educational-promotional field, without in any degree sacrificing that element of wholesome trade rivalry so essential in the interest of public welfare. Were it not for the work this Association has been doing for nearly twenty years, the public would still be largely without knowledge of the usefulness and adaptability of concrete, which is now a prime basic necessity in the forward march and progress of modern civilization.

This Association recognizes its responsibility to the public, as is evidenced by the constant effort it puts forth to prevent abuse or misuse of cement, correlated with its endeavors to advance its proper use. Through the research work of its Structural Materials Research Laboratory, which is maintained jointly in co-operation with the Lewis Institute, Chicago, new knowledge is being attained as to how cement should not be used, as well as how it should be used. Our most capable and conscientious architects, engineers, and contractors rely increasingly upon this Association for "concrete" facts; and through these professions the best interest of private owners, municipalities, and taxpayers generally are served and protected.

To know the possibilities of cement as disclosed by systematic and methodical research, to spread broadcast through Association literature and advertising, these findings for the benefit of mankind in order that concrete (in which cement is the basic ingredient) shall give the greatest service possible,—in brief, to improve and extend the uses of concrete, are the objects of the Portland Cement Association.

In the Association's scheme of organization and policies the ideal of democracy is its guiding principle; any cement manufacturer may belong to it: no cement manufacturer need belong to it. Each member, without reference to size, has but one vote in helping to establish and promote its policies.

It is through the principles and practices adhered to in the conduct of this Association's work that its members express; (1) recognition of their responsibility to the public; (2) faith in the utility of their product; and (3) belief in the value and necessity of research-educational-promotional work as a delevoper of their markets.

Sixty-Foot Columns Economical in Five-Storey Building

In all office building construction, a saving in the time of erection always means a direct saving in the cost of the building, for the floor space is rented sooner and a return on the money invested is obtained. For this reason, anything that can be done to speed up the erection of the frame of the building will be found to be economical.

This was found to be the case in the erection of a five storey steel frame office building at Santa Rosa, Cal. Here, the time of erection was shortened by using columns sixty feet long. The columns were made strong enough to carry the load from the bottom floor and erected as one unit. The first-storey columns had to be of a considerably heavier section but from the second floor to the roof was erected in one piece.

It was found that the saving in splice plates and rivets and the shop work saved by the elimination of the splices more than made up for the extra material required to give sufficient area at the lower end of the column. Another item of delay eliminated was the necessity for repeated raising of the derricks as is the ordinary procedure when erecting two storeys at a time. It was unnecessary also to plank entire bays for rivetting.

Co-operative Tree Planting

The Forestry Branch of the Department of the Interior, Ottawa is distributing a bulletin which presents in a few pages the results of the co-operative tree-planting plan, established about twenty years ago, by the Dominion government to assist prairie farmers in protecting their farm buildings and gardens by shelter-belts of those kind of trees which tests have proved suitable. The stopping of soil-drifting by wind-breaks is also dealt with. An estimate is made of the cash value of the sixty million trees which have been sent out from the Dominion Government nursery stations, but the greater value is found in the increased comfort and homelike surroundings of prairie homesteads since the plan was inaugurated. In the pamphlet forty farmers scattered over the prairies from Winnipeg to Calgary, tell of their success under the plan. While the free distribution of trees under this system is confined to the Prairie Provinces the work affects the whole of Canada, because improved conditions in one part must benefit all Canada, and because it shows that if trees of valuable kinds can be got to grow in what was once considered a treeless region a great opportunity exists for improving forest conditions and in growing timber in all parts of Canada.

New Schools and Library for Edmonton

Ratepayers of Edmonton, Alta., on May 29 passed two money by-laws involving $175,000 for schools and $37,500 for library. Five others, which would have called for bond issues totalling $371,000 for a power plant, telephones, street improvements, and market stations, were defeated.

Two Causes of Fires in Dwellings

Two great causes of fires in dwellings are faulty construction and human carelessness, rather than the use of wood or of any other particular construction material. If occupants were more careful about matches, smoking, rubbish, ashes, open fires, open lights, and if builders did not permit defective unlined chimneys and flues, inadequate fire-stopping, defective wiring, etc., the fire loss in dwellings woul dbe greatly diminished.

The Present Trend of Highway Development

By Prevost Hubbard

It is an almost incomprehensible fact that in building our highway systems more weight has not been attached to the paving practice in our cities where many of the problems of meeting heavy and varied traffic conditions were successfully solved before such conditions made their appearance on country and suburban highways. In our cities the original waterbound macadam and gravel roads have for the most part given way to higher types of construction until today they constitute an average of only about 26 per cent. of the total yardage. The three most widely used city types are asphalt, brick and stone block. If we eliminate the water bound pavements we find that of the higher city types asphalt constitutes about 55 per cent., brick about 19 per cent. and stone block about 14 per cent. giving a total of 88 per cent. for these three types.

In connection with the preponderance of ashpalt pavements, the present trend of paving practice in the construction of modern brick and stone block pavements is of considerable significance, as it recognizes a principal which just now is attracting a great deal of attention on the part of our highway engineers. I refer to the use of a flexible jointfiller for brick and block pavements as against the rigid grout fillers formerly so popular. Such cities as New York and Philadelphia are now using asphalt fillers for heavy traffic streets paved with stone block and the Paving Brick Manufacturers' Association are preferentially recommending asphalt as a filler for their type of pavement. The reason for this lies in the fact that absolute rigidity in a pavement structure is not a desirable characteristic. Service results and comprehensive field tests conducted by the U.S. Bureau of Public Roads have demonstrated that the brick or block pavement with a flexible filler is more resistant to traffic than with a rigid filler. A certain degree of flexibility is highly advantageous in meeting the heavy impact of modern traffic. Such flexibility is an inherent characteristic of bituminous pavement and is imparted to brick and block pavements when asphalt is used as a joint filler.

Flexible Types Predominate

While in certain sections of the country the experience of our cities appears to have been overlooked, it is a fact that the flexible of semi-flexible types of construction pre-dominate in our country roads and if we consider the total mileage of highways higher than gravel and macadam, considerably more than 50 per cent may be so classed. By reducing all yardage to a basis of 16 feet width we estimate that at least 45 per cent of mileage of the higher types of pavements are the hot-mixed asphalt types.

There are, it is true, many advocates of the all rigid monolithic types of construction and in certain sections such pavements predominated in last year's work. Those who favor rigid construction have constantly been obliged to increase the massiveness of design of such pavements and also the amount of reinforcement in an endeavor successfully to meet the destructive action of heavy traffic, while those who have favored the semi-flexible or flexible types have, in general, found that the old standards of design have poven satisfactory. The all flexible types, such as the black base pavements appear to be the most highly resistant per inch of total thickness, and may therefore be considered the least massive and in this respect the most efficient of the heavy traffic pavements.

Waterbound Base

What we have learned in the last few years about the destructive effect of traffic impact and the resistance to impact offered by semi-flexible and flexible highway structures has a peculiar significance in connection with a great economic problem, that of conserving our investment in old roads, particularly gravel and macadam, when it becomes necessary to adopt a higher type of wearing surbace. Prior to the careful investigation of this important subject there existed a marked and growing tendency to discredit the use of old gravel and macadam roads for foundation for the higher types and this in spite of many remarkable service records of macadam foundations. For example, in the City of New York, a number of the most heavily travelled streets were constructed years ago on macadam foundations and some are still giving satisfactory service.

One reason for much of the former dissatisfaction for such bases was undobtedly due to a fault which has been all too prevalent in the rapid development of our country highway system. I refer to inadequate preparation and drainage of our sub-grades, fostered by the false idea that the cost for such work would make the total cost prohibitive. Political pressure and popular demand for the rapid construction and the greatest possible mileage of improved roads for a given amount of money has been, to a great extent, responsible for this state of affairs. However, this subject is receiving an increasing amount of attention and is being most carefully investigated by the government and a number of public service bodies and technical societies. Most of our highway engineers are now fully alive to the importance of this subject and marked improvement in our present practice of subgrade preparation and drainage will shortly follow.

Overestimation of Thickness

There is one common fault in the utilization of old roads for foundations which has often resulted disastrously. This is the over-estimation of thickness of the old road. All too frequently we have laid an expensive pavement on an old road, actually 3 inches or less in thickness when it had been estimated as not less than 6 inches or 8 inches thick. Macadam and gravel roads wear away very rapidly in comparison with other types and because records show that a large tonnage of road meal has been used in the construction and maintenance of the old road it does not by any means follow that most of such material is still on the road. It is very essential, therefore, accurately to determine the existing thickness of the old road before utilizing it as a foundation.

Wherever possible the old road should be left undisturbed rather than to scarify and reshape it, which destroys much of the stability that compression under traffic has brought about. It is quite necessary that the old surfaces be trued up before the wearing course is laid but if the reconstruction is to be completed in one operation placing of a bituminous mixture in existing depressions will usually prove to be the best practice. If the existing road is not sufficiently thick to serve as a foundation it may conveniently be reinforced with a thin course of black base mixture before the wearing course is laid.

Description of P & H Equipment

"Excavating Equipment," is the title of bulletin 57-X just published by the Pawling and Harnischfeger Co., of Milwaukee. This publication describes and illustrates in its 36-pages P & H gas-driven "8 in 1" excavators of various sizes and types, including full circle swing gas shovels, draglines, grab bucket cranes, material handling cranes, and the other rigs to be used with this machine, as the skimmer scoop and pile-driving rig, and such accessories as may be used with these cranes, as the backfilling scraper bucket, hook and sling chains, and electro magnet. This bulletin supersedes No. 56-X with additional information on the 208 and 210 excavators.

Bulletin on Fire Waste

The Department of Insurance, Ottawa, has undertaken the publication of a bulletin with a view to calling public attention to the rapidly increasing fire waste in Canada. It is generally felt by the Dominion and provincial fire officials that to deal effectively with the situation the general public must be aroused to a greater sense of individual responsibility for existing conditions. The value of property destroyed by fire in the Dominion, in 1921, was something over $45,000,000—half enough to pay the interest on our national debt. The Department hopes that their bulletin will be of assistance in reducing this tremendous fire loss.

Mainly Constructional

East and West—From Coast to Coast

Hon. J. L. Perron, Minister of Highways of Quebec, spoke recently at the banquet of the Granby Automobile Association, held at the Windsor Hotel, Montreal.

The sum of $25,000 has been allowed in the supplementary estimates of the Public Works Department, for a new wharf at Pembroke, Ont. Actual construction will not commence, however, until next winter.

A report from Saskatoon states that the demands of the bricklayers for $1.15 an hour are being met by many contractors and, as a result, the strike that has been on for the past six weeks or so is practically at an end.

After having been idle for several years, the Sinden brick and tile yards at Tillsonburg, Ont., have been purchased by Cowell Bros., who have already started necessary repairs and additions, and will be turning out brick in a few weeks.

It is estimated that about 100 carpenters are on strike at the present time in Toronto, as a result of a recent cut of 10 cents per hour in wages by the contractors. The strike is not general, there being several men still at work who state they are receiving the union rate.

According to a recent announcement a $3,000,000 church will be erected at Ste. Anne de Beaupre, P. Q., to replace the old structure which was destroyed by fire recently, also a Redemptorist monastery to cost $500,000. The announcement also states that a contest in which all Canadian architects would be eligible, is being considered, the prize for the successful design to be $15,000.

The Canadian division of the Pere Marquette railway has commenced a program of re-ballasting the entire road bed of its lines in Canada. It is estimated that sixty cars of gravel per day will be required for this work. Many other improvements on this company's Canadian lines are proposed for the present season, including the laying of steel and replacing of ties.

Road work in York County Ont., has been commenced in earnest. About 300 men are employed on twenty different sections being improved at the present time. The greatest activity is at present centred around Todmorden, Highfield, Weston, Agincourt, Unionville, Sutton, King and Downsview. It is estimated that the cost of roadwork this year is from 10 to 15 per cent less than 1921 figures in this county. Supplies and labor are plentiful and it is anticipated that in two months time, the work which has been started will be completed.

The amount of building represented by the permits issued during the month of May at Toronto broke all records for any month in the history of this city. Last month's figure was $4,195,000, the previous record being $3,900,000. The bulk of last month's record figure was made up by residence permits, these totalling $2,700,300. The grand total for the first five months of this year, at Toronto, is $13,501,754, an increase of $4,513,620 over the same period last year.

The Russell Construction Co., of Toronto, who submitted the lowest tender for the construction of the new Gerrard street bridge over the Don river, was awarded the contract. His bid was $721,519, as compared with two other tenders of $739,272 and $743,781.

The Hepworth Silica Pressed Brick Company, Limited, at Hepworth, Ont., has been reorganized under the name of the Hepworth Brick Company, Limited, the bondholders of the old company having taken the plant over and operations were begun recently. The new company will specialize in sand-lime brick for the making of which the sand in Hepworth district is well adapted.

Obituary

The death of Mr. R. J. Long, secretary of the Winnipeg Builders' Products Association, was reported in that city recently.

Personal

Mr. H. L. F. Blake, mining engineer of Ottawa, Ont., left recently at the head of an expedition to the Ungava District in search of minerals. The expedition is being financed by British interests and includes four or five Britishers and about a dozen Indians.

Trade Incorporations

Johnson & Lamarre, Ltd., with head office at Montreal, capital $20,000, to carry on the business of painters and decorators.

Bouret, Limited, with head office at Quebec, capital $20,000, to carry on a general contracting business.

United Building Corporation, Ltd., with head office at Toronto, capital $60,000, to carry on a contracting business.

E. O. Leahey & Co. Ltd., with head office at Ottawa, capital $150,000, to carry on the business of general contractors and to deal in building materials.

Coland Construction Co. Ltd. with head office at Toronto, capital $40,000, to carry on an engineering and contracting business.

Moore, Broadbent Co. Ltd., with head office at Montreal, capital $50,000, to manufacture and deal in paints and oils.

Heath Unit Tile Co. Ltd., with head office at Toronto, capital $50,000, to manufacture and deal in clay products and builders supplies.

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Cost Systems for Contractors

A greater appreciation of the value of cost systems is badly needed by the construction industry, especially by the smaller builders. Large contractors have, for the most part, adopted some form of cost accounting that gives them an accurate knowledge of their operations, but most builders operating on a small scale are able to tell if they have made a profit only if their bank balance grows. In what specific operations they are making money or in what operations they are inefficient and losing money, they are unable to determine. As for estimating, such contractors have only general ideas to work on and have no thorough analysis of past experience upon which to base figures relating to proposed work.

Authorities have stated that a large proportion of the many business failures recorded every year are due to the absence of an accurate knowledge of what it costs to manufacture and sell. This is as true of the contracting industry as of any other and if one were to intimately examine the causes for the assignment of many contractors, he would discover to what a large extent the absence of a cost system has influenced failure.

Cost accounting has three prime functions: (1) to aid in assuring the economic handling of the work while it is in progress; (2) to obtain figures to compare with the estimate, and, (3) to supply data for use in estimating future work. The first of these functions is the most important. By a proper cost accounting system and its judicious application, it is possible to discover whether inefficiencies are creeping in and to suggest remedial measures. To be effective in producing savings while the work is in progress, it is essential that costs must be available as soon as possible after operations are completed. This involves an organization in both office and field for the collection and analysis of proper figures. It is the cost of this organization that seems to stand in the way of the introduction of a cost system by many firms. However, the experience of large contractors is that the expense in this connection is but a small fraction of the savings that are possible.

The relation of a cost system to the estimating department is important. Not only is it desirable to compare cost figures with the estimate in order to correct any errors in the latter, but it is also advisable to use cost data from one job as a basis for estimating on future work. Too often estimating is a purely guessing process in which past experience has not been properly utilized. Proper analysis of costs will supply the estimating department with such data as will enable it to estimate within a reasonable degree of accuracy and with the prospect that the cost will not differ much from the estimate. Were all contractors to adopt a suitable cost system, the wide discrepancies apparent in many tenders would be rare. An example of the wide difference between high and low bids was given in the last issue of the Contract Record in connection with a report of the tenders for the Chemistry Building of the University of Saskatchewan. On one trade there was a 35 per cent. discrepancy between the extreme tenders—a difference that is far too great, even allowing for differences in the organization and methods of the different tendering contractors. An improvement in the estimating situation can only be secured when contractors realize the advantages of an adequate cost system. Small contractors especially should eliminate the haphazard guesswork that has so frequently characterized their efforts. If they would install suitable methods for acquiring a knowledge of the costs of their operations, they would be on the way toward making greater profits.

Building Industry Steadily Improving

Building permits for May, 1922, are the largest for any May since the outbreak of war —22 per cent. over the same month a year ago. The figures to June 1 are:

May, 1921,	$26,859,000
May, 1922	$34,827,300
First five months of 1921,	$85,326,000
First five months of 1922,	$96,831,000
Gain during May	22 %
Gain for year to date	13.5%

Water Supply System for the Rural Municipality of South Saanich, B. C.

Six Square Mile Area in Which Water is Being Supplied from the Gravity Main Which Feeds the City of Victoria—Ten Miles of New Mains—Estimated Cost $175,000

By **J. B. HOLDCROFT, A.M.E.I.C.**
Contract Record Correspondent

An interesting example of water supply practice in its application to the requirements of the rural districts contiguous to cities is afforded by the work now in hand by the municipality of South Saanich, B. C., which lies just to the north of the city of Victoria. The water supply project now in hand is one designed to serve, not the whole municipality, which is of very considerable extent, but a section known as the Gordon Head District, which from the character of its settlement and local conditions is peculiarly in need of a water supply from an outside source.

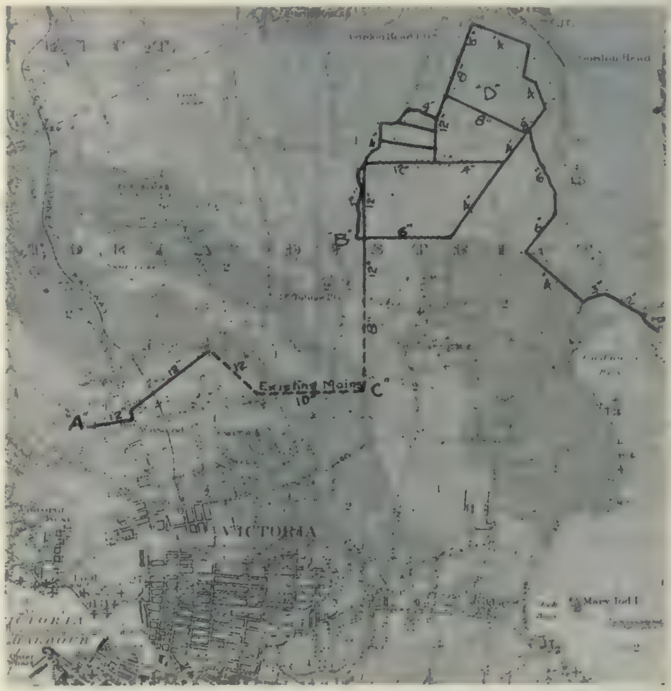
This district, which covers an area of about six square miles, has become well known in British Columbia in recent years as a fruit farming center, and the residents have specialized in the production of small fruits, especially strawberries, which, in a season with good growing weather, ripen earlier than similar crops in other parts of the country. One serious drawback, however, has been the lack of water. The rainfall for the Victoria district has an average of about 28 inches per annum, and very often the showers of early summer, which are depended upon by the fruitgrowers for filling out the berries, do not materialize. A permeable substratum adds to these difficulties by making it almost impossible to secure a satisfactory supply from wells, which would provide enough water, in addition to that required for purely domestic purposes, to ensure the berry crops receiving sufficient irrigation to ripen well in a dry season.

Under these circumstances, and with the necessity of better water supply conditions increasing from year to year as the extent of land under cultivation increased, there has been for some years an active campaign on the part of the residents to obtain the needed extensions. One of the most serious obstacles in the way was the fact that the area in question is, as has already been mentioned, only a small part of the municipality, and for some time the movement was delayed, pending the evolution of terms which would be satisfactory to all and work no injustice to the sections which could not be benefited by the proposed works. These were finally arrived at and in 1920 Mr. J. E. Milne, A.M.E.I.C., was engaged by the council to report upon conditions and to design a system which would meet the needs of the district in as economical a manner as possible.

Source of Supply

Only one source of supply was ever seriously considered, viz., the gravity main which supplies the city of Victoria, and which has a capacity far in excess of the needs of the city for many years to come. The utilization of any source other than this, although several such may be considered to exist, would have necessitated a longer main pipe and would have added the cost of headworks and all the other items of expense which go with the development of a new water supply system. The decision to utilize the supply thus offered through the Victoria main, which was made available to the municipality at a reasonable rate of charges, practically decided the further question of the route which their own feeder main must take, the construction of which was facilitated by the existence of mains of considerable size along a portion of the route to be taken.

Portions of the area to be supplied had been piped with temporary mains of small diameter, and one of the first actions of the engineer in assuming his duties was to undertake a series of tests to determine whether any portions of these temporary mains could be utilized as part of the permanent system to be installed. Measurements were also taken of the actual consumption of water in certain well defined areas, with the object of determining as closely as possible the correct allowance of water, figured both on the per capita basis and in terms of the acreage; this in view of the fact that it was known from the start that a certain amount of the water was required for purposes of irrigation. It was quite certain, however, that it would be out of the question, due to considerations of cost, to consider an irrigation supply at all comparable with that usually figured on in the irrigation districts



Map of the municipality of South Saanich, B.C., showing location of water mains of the province, where an application of from twelve to sixteen inches during the season is considered necessary. These portions of the province, however, have an average annual rainfall of only ten inches, which with the irrigation supplied makes a total of from twenty-two to twenty-six inches. The district now in question has an average precipitation of about twenty-eight inches, so that it is evident that any irrigation system installed would be supplementary in character, and would fulfill the duty of bridging over dry periods during the growing season rather than furnishing the bulk of the water required.

Construction Economy

Owing to the fact that at present the area to be served is somewhat sparsely settled, compared with what is to be expected in the future, economy of construction was a matter for first consideration, and it was inevitable that any attempt to reconcile the various factors influencing the problem of design would result in some sort of a compromise. This was found in the decision to use portions of existing watermains along the route chosen for the connection to the Victoria trunk main, to which about a mile of 12" cast iron pipe has to be added to make the connection. The portions already constructed are shown dotted on the map reproduced herewith and new pipes are shown in full lines. The old pipes along the line of the main vary in size from 12" down to 8", and have a capacity at the commencement of the principal network of 562 gal. per min. This is calculated as sufficient for a population of 7,600 persons, on a basis of 100 gal. per day per capita for all purposes. In addition to this distribution point, which is marked "B" on the map, a second supply point is allowed for at "C," which is to supply the district south of the hill shown, Mt. Tolmie. One hundred and seventy four gal. per min. are allowed for this point, which will serve a population of 2,500 persons on the same basis. Tests have shown that this particular area is now drawing water at the rate of 25 gal. per min. from the temporary mains, so that on the population basis it appears that multiplication of the present population by seven is anticipated.

Left: Day labor gang laying 18 in. main for South Saanich water supply system. Right: Standard fire hydrant and connections to main

The area of the whole district is approximately 3,700 acres, which, divided into the number of people provided for, shows that the eventual distribution of population is expected to average 2.7 persons per acre or 1,728 per square mile. This seems a high allowance but is based on the belief that this district will be one of numerous small holdings. The supply available at the summit area, marked "D," is 375 gal. per min. at a pressure of 16 lbs. per sq. in., and is sufficient for 5,000 persons.

Irrigation Possibilities

The report then proceeds to deal with the irrigation aspect of the project and states that under the hydraulic conditions obtaining at the summit area the supply would be sufficient to irrigate 13 acres to a depth of 0.26" in 24 hours. It is recognized that this is a small allowance for the purpose, and the engineer contemplates the necessity of arranging a schedule of hours during which the supply can be utilized by the various consumers, so as to avoid pulling down the operating head too far and thus causing a failure of the supply at the summit of the district. It is also considered necessary to have storage tanks of small size installed in the houses to ensure continuous supply for domestic purposes.

Ten miles of pipe are included in the main and distribution system from the point of connection with the existing pipes which are to be utilized, and to this must be added about a mile of 12" pipe to make the connection to the trunk main. Cast iron water pipe of English make is being used for all sizes down to 3", after which galvanized steel pipe with threaded joints is used. The pipe weights specified are: 12", 91.7 lbs. per ft.; 8", 52.8 lbs. per ft.; 6", 35.8 lbs. per ft., and 4", 23.3 lbs. per ft. Pressures in the system will vary from 103 lbs. per sq. in. to 16 lbs. per sq. in., the average being about 48 lbs. All pipes are tested to 300 lbs., after being laid.

Estimated Cost of the Scheme

The scheme has been divided into two portions, in view of the fact that the district is, as has been said previously, still rather sparsely settled, comparatively speaking. The present by-law contemplates the expenditure of $137,647 plus financing costs, which bring the total up to a bond issue of $162,000. This includes the whole of the scheme as outlined, with the exception of the mile of 12" main connecting with the trunk main, which is to replace a present temporary pipe of section too small for the requirements. The cost of the 12" connection has been estimated to be $37,677, making a total for the work, omitting the financial items, of $175,324.

Work has now been in progress for about six weeks or two months and about half of the pipes in the network have been laid. Owing to reductions of about 30% in the cost of materials and 20% in labor costs since the estimate was made, a considerable saving is anticipated and the municipality hopes to be able to complete the entire scheme under the one by-law.

The municipal handbook of the city of Toronto for the year 1922, compiled by city clerk W. A. Littlejohn, has just made its appearance.

Skill, Integrity and Responsibility

How Contractors Can Build up Pleasant Relations Between Themselves and Their Clients' Representatives

By C. H. McALLISTER
Before the Cleveland Engineering Society

It is the aim of the responsible contractor to do reliable skillful and honest construction satisfactory to the owner and his representative, the engineer —creditable, as well as profitable, to the contractor himself.

The relationshp between the owner and the contractor should be one of mutual responsibility and of close co-operation, by which the interests of both can best be served; and, by the promotion of this co-operation, the responsible contractor seeks to avoid, as far as possible, differences of opinion, opportunities for misunderstandings, and very often expensive law suits. All of these not only breed suspicion of the contractors in the mind of the engineer, but result in the writing of specifications, so full of one-sided clauses, restrictive beyond reason, that the contractor is encouraged to gamble—if he bids at all—adding an unreasonable amount for contingencies, which he fears may arise in carrying out a contract in which the engineer has reserved unto himself arbitrary authority and has decided in advance questions concerning responsibility, which very often arise through the design of the structure or the written provisions for its construction. The irresponsible contractor is largely to blame for such restrictive clauses in specifications and this is particularly true of public works contracts. To eliminate conditions which encourage irresponsibility, embracing as it does unfair practices, defective work, deliberate violation of agreements, etc., one suggestion is to set up a plan for the promotion between owner and contractor of that relationship of mutual responsibility which will insure the elimination of unfairness and establish that co-operation which will ultimately result in a saving of time, money and temper to both parties of the contract.

Standardization of Specifications

The first step is the standardization as far as possible, of specifications, particularly of those general clauses which either mean so much or so little.

Plans should be clearly drawn and should be complete before they are given out. The opportunity for disputes because of additions, eliminations or deductions should be reduced to a minimum.

Borings or test pit evcavations should be made and the results published by the engineer. It is the general practice to make borings, exhibit them, and then disclaim responsibility. There is more trouble in connection with foundation work due to lack of reliable information as to soil conditions than there is with any other class of general construction; and while we realize that the present hit or miss method of making borings is very unsatisfactory and misleading, we believe that borings can be made or test pits dug which will fairly represent undersurface conditions. This information will in itself tend to eliminate the opportunity to gamble and to prevent unbalancing of bids, saving many times over the cost of the preliminary investigation, besides giving the engineer himself reliable information from which to accurately design the important substructure and save numerous revisions to his plans as originally submitted for competitive bids.

Of course it will be said that the bidder is notified to carefully examine the site of the work and satisfy himself by borings or test pits as to the conditions existing. The time allowed for the preparation of bids is usually of short duration: and, even should the responsible contractor wish to make borings, it is likkely that he would need official permission to make them on public property, particularly on streets and highways. We hold that the furnishing of this information should be as much a part of the owner's duty, as is the furnishing of the plans and specifications governing the construction of the work.

The Gamble in Contracting

In examining plans and specifications before the submission of a bid, the responsible contractor generally designs a plant layout for the handling of the work. Of necessity he must use the approximate quantities which are submitted to him as a part of the specifications for the design of a plant layout. Consider how he must necessarily gamble on this large item alone, if he is furnished with quantities which are not appropriate. Of course, we realize that a statement of quantities must be appropriate, but they should vary only by a small percentage. Many instances could be cited to show the unreasonable expense to which contractors have been placed through the failure on the part of the owner and his representative, the engineer, to give the bidders this information at the time of requesting the bids. When the engineer realizes that the bidder's estimate depends so largely upon the correctness of the quantities given, and that these are not only for the purpose of a comparison of bids but are so essential to the responsible contractor in preparing his bids, we are sure he will then consider it of great importance to himself, as well as to the bidder, to have these quantities as nearly correct as it is possible to get them. Specifications, of course, contain clauses advising the bidder to satisfy himself as to these approximate quantities, some specifications even placing upon the contractor the obligation of checking the plans and specifications and imposing upon him the duty of notifying the engineer of errors of omission or commission. It is unreasonable to expect the contractor with his engineering working force to do in a few weeks what it has taken the owner's engineering force several months to do. If a responsible contractor took cognizance of all such clauses, it would mean the employment by him of an engineering office force, the cost of which, added to his overhead, would mean his inability to compete against the irresponsible contractor for any work at all.

Standardize Specification Clauses

The co-operation of the engineering fraternity is earnestly requested in the standardization of general clauses of specifications. It is our desire to eliminate clauses which are restrictive, indefinite, and which would probably tend to promote serious misunderstandings. It is also our desire to have clauses which definitely restrict the irresponsible contractor from prosecuting his work in an unskillful manner and attempting evasion of clauses covering honest construction. We believe that there is a necessity for intelligent and trained supervision, and realize that a favorite clause in specifications which provides that the contractor shall make good any defects, even though the work has been inspected, could be strengthened to the advantage of both parties by providing that the owner shall furnish competent inspectors, rather than men who get positions because of political influence. An inspector of experience and engineering training who is fair minded is often able to adjust without a wrangle questions, the settlement of which in the hands of an incompetent representative of the engineer in charge would cause trouble between the engineer and the contractor.

Employer-Employees Relations

Many specifications covering public works construction privide restrictions on the contractor in relation to his employees. These clauses restrict the contractor to the number of hours which shall constitute a day's work and a week's work, and also provide a minimum rate of pay. Despite the fact that such restrictive clauses are made a part of the contract, some contractors are permtted to openly violate them, while others are held strictly to their enforcement. If incorporated communities recognize the law covering such restrictions and embody them in their specifications, it is fair to those contractors who have submitted bids for such work and who intend to live up to these clauses, that these communities should also act when these clauses are disregarded.

We are pleased to note that several specifications which have recently been issued contain a clause covering arbitration. The American Institute of Architects and Federated American Engineering Society recognize the principle of arbitration in their present standard building contract form, and we believe that this is one of the most vital matters which has come to our attention in connection with our study of the relation between owners and contractor. No fair-minded engineer questions the right of the contractor to present his side in a dispute, who would gladly submit his case to a board of arbitration as provided for in a contract, unless he willfully intended to evade his responsibility. We are therefore in favor of embodying in the general clauses of the contract a provision for arbitration which which will provide for a settlement, as far as possible, of all disputes which may arise in the interpretation of the specifications or in the execution of the contract.

What of Concrete Aggregates?

We believe that specifications covering the proportioning of the aggregates used in mixing concrete should be simplified and strengthened. The responsible contractor bases his estimate on the use of satisfactory material; the irresponsible contractor generally figures on the cheapest material it is possible to buy, regardless of its quality, and hopes by some means to have this material passed if he secures the contract. Because of the conditions existing at different places, as far as variety of materials is concerned, specifications should definitely cover the quality desired by the owner, and there should be no opportunity for the irresponsible contractor to become misled through the specifications. It should be the duty of every reputable engineer to thoroughly investigate the quality of the materials available for his work, so that he may definitely specify what is to be used. The specifications covering the proportioning of the aggregates should be carefully drawn. Many times expensive cement is wasted, because of the indifference of those interested in the proper proportioning of the aggregates. If this was given careful attention, the reputable building supply dealers in the various communities would of necessity have accurate information for the contractor as to the weight of the aggregates per cubic yd., the percentage of voids contained in such commodities as gravel, crushed stone and slag, and would also furnish through their sales department a report on the character and quality of the material.

Special Type of Sand Vessel

The National Sand and Material Co. Have Ordered the First Boat of Its Kind Built in Canada

The Collingwood Shipbuilding Company on May 27, launched the steamer, Charles Dick, which they built to the order of the National Sand & Material Company, Limited, of Welland, Ontario. The vessel is of special construction for carrying sand and gravel and has special loading and unloading pumps and machinery.

The ship is 258 feet over all, 43 feet in beam, 20 feet deep, and will have a dead weight carrying capacity of approximately 3,000 tons. The vessel is classed B.S. under the rules of the British Corporation for the Survey & Registry of Shipping and embodies all the latest improvements for a ship of this special type.

The machinery and boilers are placed aft. The hold is divided into two large hoppers, each 60 feet long and will carry approximately 2,000 cubic yards of sand and gravel. Between the hoppers is an engine room 10 feet long, which will contain the unloading machinery.

The pump room is built forward of the forward hopper to accommodate two 18-in. centrifugal pumps directly connected to compound condensing engines, having cylinders 13-in. and 26-in. by 14-in. stroke. The 18-in. suction from each of these pumps is directly connected to the shell, five feet above the keel, and a special feature of this ship is the recessing of the shell plating, accommodating guides down which the outboard suction pipe flange will slide. These suction pipes are portable and removed when the cargo has been loaded. The pumps discharge the material on troughs running over the top of the hoppers. The excess water is discharged through specially designed spillways at the end of each hopper.

A special unloading device erected on "A" frames runs the full length of the hopper and accommodates large clam shell buckets. These remove the material from the hold and discharge into a special hopper amidships, the material falling on to an elevator arrangement which passes it up to a conveyor, which in turn discharges it on the deck. The space between the main hoppers at the ship's side is divided into several compartments, and there is a trimming tank and fore peak tank forward. There is a dry tank under the boilers and water ballast tank under the engine room.

The captain and crew are accommodated forward and the deckhouse aft contains the dining saloon, mess-room, galley, engineers, etc.

The vessel is being specially built to supply material for very large contracts. It is the first of her kind to be built in Canada.

Difficult Retaining Wall Construction at New Westminster, B. C.

Removal of Timber Crib Walls and the Substitution of Mass Concrete —Difficult Conditions under Which the Work is to be Undertaken—No Traffic Interference

By J. B. HOLDCROFT, A.M.E.I.C.
Contract Record Correspondent

A piece of construction, ordinary enough in itself but made difficult by the conditions under which it must be undertaken, is being offered to contractors by the Provincial Department of Railways of British Columbia. The work consists of the removal of some old timber crib retaining walls and the substitution therefor of walls in mass concrete. The work is in two parts, the first section being 1,375 feet in length, with a maximum height of 14 feet, and the second section being 330 feet long with a height varying between 5 and 9 feet. The first section will contain 3,000 cubic yards of concrete with 7,000 cubic yards of excavation, while the second will consist of 350 cubic yards of concrete and 780 yards of excavation. Expansion joints will be provided at intervals throughout the length of each wall and seepage will be carried away by tile drains of 4 inch clay pipe laid along the embankment side of the wall.

Traffic Interference Must be Avoided

The difficult feature of the work lies in the fact that the present crib wall is supporting the track which carries the Canadian National Railways and Great Northern Railway main line traffic above Front Street, New Westminster's main approach to the wharves and railway stations. Twenty-five feet from the face of the wall is the C. P. R. local branch line, this space of twenty-five feet being the principal artery for vehicular traffic from the wharves. It is therefore necessary to arrange the work so that the traffic on the main line is not interfered with or endangered and at the same time interfere as little as possible with the traffic on Front Street.

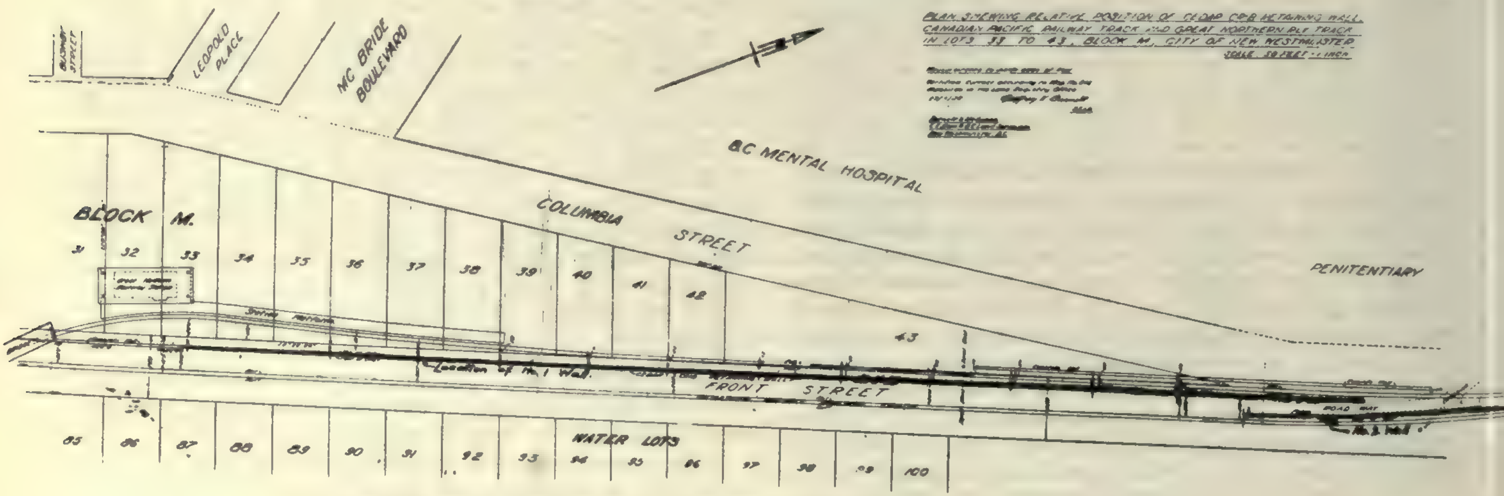
The first object, that of ensuring continuity of traffic on the railway line, will be met by arranging to construct the new wall in sections of not more than twenty feet at a time. While this will undoubtedly result in considerably lengthening the construction period, it is considered advisable to handle the work cautiously and without any risk that can be avoided. While each twenty-foot section is open during the demolition of the timber crib and construction of the concrete wall, the outer rail of the track will be supported on a stringer twenty-eight feet in length which, in its turn, will be supported on caps, posts and mudsills resting on hardpan or other solid foundation. It is planned to use the timbers in the false work described progressively from section to section, and it is probable, in view of the short sections to be built at one time, that the contractors will be able to make equally economical arrangements with regard to the form work for the concrete. The work of supporting the tracks will be under the direct supervision of a superintendent appointed by the railway company.

Storage Space Limited

The city of New Westminster is allowing the use of eight feet of the roadway for construction purposes, leaving about fifteen feet open for vehicular traffic. This is another awkward feature of the work and will make it practically impossible to store any material on the job except that required for immediate use.

The wall and the track supported by it are a portion of the approaches to the Westminster Bridge across the Fraser River and, consequently, the property of the provincial government, under the control of the Department of Railways.

Mr. A. Forbes Proctor is chief engineer of the department and Mr. R. W. Macintyre, principal assistant engineer, is directly in charge of the design and construction problems of the present work which is expected to cost about $60,000.00.



Location of retaining wall supporting tracks of the C.N.R. and G.N.R. in New Westminster, B.C.

Construction Developments During the Month of May

Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded and Contemplated

Construction Contracts Awarded in Eastern Canada, May, 1922

	Ontario		Quebec		New Brunswick		Nova Scotia		Eastern Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	13	$ 685,500	5	$ 140,000	....	....	....	....	18	$ 825,500
Churches	8	320,000	7	468,000	2	$ 95,000	....	....	17	883,000
Factories	12	587,000	5	135,000	1	6,000	1	$ 50,000	19	778,000
Garages	21	233,300	32	75,000	....	....	5	25,000	58	333,300
Hospitals	3	112,000	....	....	....	....	....	....	3	112,000
Hotels and Clubs	4	83,000	5	603,000	....	....	....	....	9	686,000
Office Buildings	6	354,000	5	166,700	....	....	3	50,000	14	570,700
Public Buildings	4	30,000	1	12,000	....	....	1	20,000	6	62,000
Residences	1779	8,582,700	654	2,936,600	78	427,900	40	221,500	2552	12,170,700
Schools	31	2,600,500	10	615,000	2	90,000	2	17,200	47	3,361,700
Stores	98	1,523,500	31	2,052,700	5	34,500	4	42,000	138	3,652,700
Theatres	1	15,000	1	60,000	2	60,000	2	19,000	6	154,000
Warehouses	7	230,000	2	25,000	1	10,000	9	53,000	19	318,000
Total Buildings	1987	$15,356,500	758	$7,289,000	91	$ 723,400	67	$ 497,700	2906	$23,907,600
Bridges	7	$ 70,600	2	$ 10,000	....	....	....	....	9	$ 80,600
Dams and Wharves	1	40,000	....	....	....	....	....	....	1	40,000
Sewers & Watermains	11	324,800	9	141,400	2	$ 65,000	2	$ 40,000	24	571,200
Roads and Streets	22	1,002,100	8	341,500	1	30,000	13	416,000	45	1,849,600
General Engineering	20	3,218,200	2	32,000	....	....	2	112,000	24	3,362,200
Grand Total	2048	$20,012,200	779	$7,813,900	94	$ 818,400	84	$1,065,700	3009	$29,811,200

Construction Contracts Awarded in Western Canada, May, 1922

	British Columbia		Alberta		Saskatchewan		Manitoba		Western Total	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	1	$ 9,500	....	....	....	....	....	....	1	$ 9,500
Churches	1	6,000	3	7,500	1	$ 5,000	....	....	5	18,500
Factories	....	....	2	17,000	....	....	1	$ 6,500	3	23,500
Garages	2	5,000	3	8,200	3	14,500	2	2,500	10	30,200
Hospitals	1	3,000	2	213,400	....	....	....	....	3	216,400
Hotels and Clubs	1	3,500	2	55,000	2	37,000	3	105,500	8	201,000
Office Buildings	....	....	1	29,000	....	....	3	63,200	4	92,200
Public Buildings	....	....	1	1,500	....	....	1	2,500	2	4,000
Residences	232	920,900	121	397,300	112	357,300	264	952,300	729	2,627,800
Schools	10	69,300	8	27,600	2	7,600	2	85,700	22	190,200
Stores	18	155,600	13	32,000	11	183,000	9	59,000	51	429,600
Theatres	2	52,000	3	30,000	....	....	1	60,000	6	142,000
Warehouses	3	21,000	1	30,000	2	7,500	....	....	6	58,500
Total Buildings	271	$1,215,800	160	$ 848,500	133	$ 611,900	286	$1,337,200	850	$4,043,400
Bridges	1	$ 197,400	....	....	....	....	....	....	1	$ 197,400
Dams and Wharves	1	345,000	....	....	....	....	....	....	1	345,000
Sewers & Watermains	2	76,700	1	$ 1,900	1	$ 6,000	2	$ 16,000	6	100,600
Roads and Streets	1	226,000	....	....	1	30,000	1	3,000	3	259,000
General Engineering	....	....	1	25,000	1	20,600	1	25,100	3	70,700
Grand Total	276	$2,090,900	162	$ 875,400	136	$ 668,500	290	$1,381,300	864	$5,016,100

Contemplated New Construction Work in Canada, May, 1922

	Ontario		Quebec		Maritime		Western		Dominion	
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Apartments	8	$ 151,600	2	$ 135,000	....	....	....	....	10	$ 286,500
Churches	13	452,000	10	571,600	2	$ 125,000	11	$ 181,200	36	1,329,800
Factories	11	465,000	8	3,666,000	2	40,000	10	305,000	31	4,476,000
Garages	29	321,000	1	56,000	1	15,000	3	8,000	37	400,000
Hospitals	2	10,000	3	275,000	....	....	2	45,000	7	330,000
Hotels and Clubs	8	260,000	6	5,099,000	2	35,000	12	91,200	28	5,485,200
Office Buildings	3	155,000	....	....	4	90,000	12	154,200	19	399,200
Public Buildings	9	248,500	3	1,200,000	....	....	10	249,500	22	1,698,000
Residences	226	1,559,600	119	1,076,500	60	313,500	252	886,500	657	3,836,100
Schools	33	1,510,000	10	235,000	5	159,000	38	316,100	86	2,220,100
Stores	36	720,000	6	160,000	9	67,000	21	303,500	72	1,250,500
Theatres	1	15,000	....	....	1	10,000	1	100,000	3	125,000
Warehouses	5	70,000	....	....	....	....	9	819,000	14	889,000
Total Buildings	384	$5,937,600	171	$12,474,100	86	$ 854,500	381	$3,459,200	1022	$22,725,400
Bridges	15	$ 142,000	10	$ 132,500	4	$ 46,400	6	$ 127,300	35	$ 448,200
Dams and Wharves	1	60,000	5	160,000	....	....	2	17,500	8	237,500
Sewers & Watermains	26	261,000	6	110,000	11	92,000	8	400,000	51	863,000
Roads and Streets	51	1,673,300	19	909,600	1	125,000	26	840,000	100	3,547,900
General Engineering	9	481,500	7	367,000	1	25,000	7	176,000	24	1,049,500
Grand Total	486	$8,555,400	218	$11,153,200	106	$1,142,900	430	$5,020,000	1240	$28,871,500

1901-1922. Mussens Limited, Montreal, Celebrate Their Coming of Age

On June 15, the Well-Known Firm, of Which Mr. W. H. C. Mussen Is the Founder and President, Celebrates its Twenty-First Birthday—One of the Leading Canadian Companies Dealing in Railway and Contracting Supplies—A Business Career Begun and Continued on the Basis of Integrity and Service.

TWO generations of our readers will join us in wishing "Many happy returns" to Messrs. Mussens Limited, the well-known Montreal supply firm, who attain their majority on June 15th.

Thursday, June the fifteenth, marks the twenty-first anniversary of the day when Mr. Mussen went into business on his own account and established the firm of which he is now president and general manager.

Mussens Limited is a name which needs little if any introduction to constructional Canada. For this very reason, considered in the light of the particularly agreeable and honorable association which the firm has had with the interests served by the Contract Record and Engineering Review their coming of age is an occasion the chronicling of which is a matter of especial pleasure.

On their twenty-first birthday W. H. C. Mussen and his associates may look back over a long period of business history, and pride themselves on having "played the game" throughout—on having played it, moreover, in the best and truest sense of the words, during a period of general upheaval and reverse.

Mr. W. H. C. Mussen,
President Mussens Limited

It will be recalled how in March, 1915, after fourteen years of successful adminstration, the firm went into voluntary liquidation. The war had carried away the foundations of the constructional industry and had left them with heavy stocks, of which they were unable to dispose in a period of growing depression, with no construction in sight. Mussens Limited went voluntarily into liquidation with a quarter of a million dollars' worth of assets in excess of their liabilities!

The troubles they experienced in the way of bad debts, loss of trade, and the general reverses which ensued, were common to the whole constructional community in a greater or less degree, but the manner in which they disentangled themselves from their encumbrances and ultimately paid off every cent of indebtedness was an individual and distinctive attainment of the highest order worthy of epic tribute.

The story is a familiar one. In March 1915, Mr. Mussen pledged his word that he would repay his creditors to the last cent. In March 1922, the firm's creditors received cheques for their final dividend of ten per cent, which paid them up in full—one hundred cents to the dollar.

The confidence enjoyed by the firm is attested to by the fact that throughout their difficulties they maintained their leading representations intact. It speaks volumes for the administrative ability of those at the helm that the firm's assets were handled so carefully, and that the equipment on hand was placed on the market at just the propitious time.

From first to last the efficiency of the Mussen organization remained unimpaired.

It falls to the lot of a few men at the helm of business to receive the universal tributes which poured in upon Mr. Mussen this spring. All sorts and conditions of men took up the strain. Every mail brought its quota. From Halifax to Vancouver the country united in acclaiming an achievement, which, of its kind, was so rare that one might almost say that it established a new standard of business ethics.

One of the neatest tributes paid Mr. Mussen —the epitaphic suggestion notwithstanding!— was that given editorially by one of the Toronto daily papers: "His name deserves an honored place in the business history of the country."

The firm may well reflect with pride upon

(Continued on page 568)

Mr. E. L. Chadwick,
Vice-president (1901-1922)

Mr. J. C. Donnelly,
Director (1902-1922)

Mr. H. B. Willmott,
Director (1906-1922)

Mr. J. M. Ward,
Director (1906-1922)

The Coming of Age of Mussens Limited

Photographs of the principal executive officers are reproduced on this page. The five uppermost have an aggregate service of over 90 years. Mr. Chadwick enjoys the distinction of having served with the firm since its inception on June 15, 1901.

Mr. E. C. Lanctot, Montreal city representative in charge of French department (1904-1922)

Mr. C. B. Huyck
Manager Vancouver Office

Mr. C. F. England
Manager Toronto Office

Mr. J. P. Frost
Manager Winnipeg Office

New Bridge Over the Columbia River at Revelstoke, B. C.

Tenders to be Received Soon for a Six Span Steel Structure With Five Concrete Piers on Piles and Two Deep-Water Piers of Steel Cylinder Design

By the Contract Record's Pacific Coast Correspondent

The new highway bridge which is shortly to be built by the Provincial Department of Public Works at Revelstoke, B. C., will be one of the largest works of its kind to be undertaken this season. The work is being divided into two contracts and the tenders for the first section, which includes the entire substructure work, are to be in the hands of the department by the 19th of June. The second contract, which will include the steel work and bridge flooring, etc., will be awarded later and it is expected that all the principal firms which are engaged in steel bridge building in Canada will submit tenders.

Foundation Conditions

The bridge, which has been designed according to the best engineering practice, will consist of six spans of which the longest is to be 215 feet betweeen supports. The necessary surveys have been carried out by the engineers of the department and borings have also been taken at the sites of some of the principal piers. This latter work was carried out under considerable difficulties and disclosed some unexpected conditions in the sub-foundation. The work of boring was necessarily undertaken during the winter while the river was still frozen over, but the season was somewhat advanced, with the break-up imminent, so that the work was carried out at some considerable risk. Satisfactory borings were obtained, however, and showed that, although a boulder formation had been confidently expected, the river bed to a depth of at least 100 feet, below which the borings were not carried, consisted of a pure white sand without very distinctly marked strata and without large boulders, except for the first few feet of depth. Previous experience with pile driving had led to the expectation that the boulder formation would be found at a much greater depth than has proved to be the case. Five of the piers to be built will be of ordinary concrete construction resting on pile substructure. The two deep water piers will be constructed of steel cylinders sunk to a firm foundation, probably about 40 feet below the river bed, by the pneumatic process. Each of these latter piers will consist of two steel cylinders, 10 feet in diameter, connected by a diaphragm of steel plates and structural shapes.

Estimated Quantities

The following schedule of estimated quantities will give an idea of the magnitude of the work included in the project.

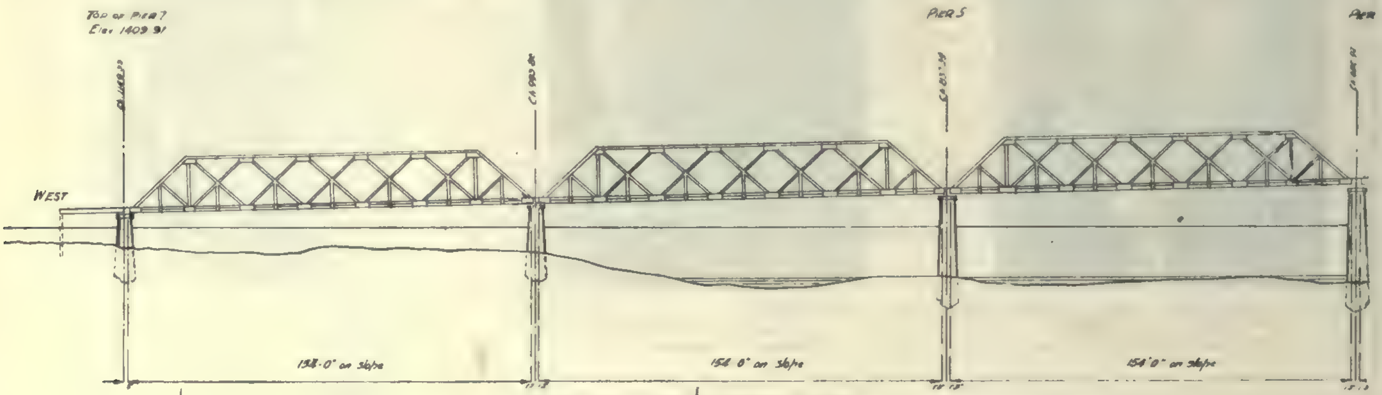
1-2½-5 concrete in pier shafts	2,850 cu. yds.
1-2-4 concrete footings, reinforced ..	480 cu. yds.
Excavation,—piers 2, 3	1,307 cu. yds.
Excavation,—piers 1, 4, 5, 6, 7	620 cu. yds.
Piles	9,000 lin. ft.
Timber in coffer dams	79 M.f.b.m.
Reinforcing steel	4,540 lbs.
Steel in cylinders and diaphragms ...	339,000 lbs.
Steel nosing for piers	5,200 lbs.
Riprap	1,160 cu. yds.

Work on the substructure, it is anticipated, will commence as soon as possible after receipt of tenders for the work and good progress should be made during the present season. Detail plans of the steel superstructure are still in the hands of the consulting engineers. The work will be carried out under the supervision of the Provincial Department of Public Works, of which Mr. P. Philip, A.M.E.I.C., is chief engineer.

Steady Work for the Paint Spray

The paint spraying process has been a long time in working into steady employment, but it may now be considered a fixture at least in railroad shops. Some roads, says Railway Age, have developed paint spraying to such an extent that a large proportion of all equipment, including both cars and locomotives is painted in this way.

The essential advantage of spraying is the greater speed with which surfaces can be covered, but it is often possible to utilize a lower priced operator



West half of the Revelstoke bridge

than would be necessary with brush painting and the total reduction in labor cost is increased proportionately. Paint can readily be sprayed in corners and crevices which would be difficult, if not impossible, to reach with a brush; and with the proper precautions practically no paint is wasted. While more paint is required to cover a given surface with a spray as compared with a brush, one coat applied by the former method is said to be equal to two applied by the latter and there is a saving of material as well as labor. It has been found possible to spray varnish, in which case an enamel finish is secured and this fact has broadened the field of paint spraying to include passenger as well as freight cars. The possibilities of economy may be appreciated by consideration of a typical example. A box car has been spray-painted by one 54-cent man in fifteen minutes, whereas it would take a 72-cent man about four hours to apply the paint with a brush. The relative amounts of paint used are nine and eleven gallons.

Pneumatic Clay Diggers Speed Sewer Tunnel Excavation

The Development of Air Driven Tools, Eliminating Picking or Blasting, Makes Possible Record Progress in Tunnel Driving

During the past eighteen months or more the use of compressed air has been extended to an important and interesting field of operations namely, the driving of tunnels through clay and hard soil. While this power medium has long been indispensable for tunneling through rock, or through soil requiring air lock methods, its use has but recently been applied to tunnel operations in stiff clay and similar material. With the aid of compressed air and through the ingenious employment of special pneumatic hammers, the driving of sewer tunnels has been greatly expedited and the cost of the work considerably reduced. How this is accomplished is told by R. A. Lundell in "Compressed Air."

In the city of Detroit, in particular, where an immense amount of sewer tunnel work has been under way, the use of these pneumatic clay diggers has been highly developed. However, they have also been used with pronounced success on similar work, in and around Chicago, and also in certain Eastern centres.

Excavation in stiff clay, hard sand or fine gravel is ordinarily laborious and expensive where steam shovel, or trenching machines cannot be used, and the material must be loosened for removal by means of hand picking or blasting. For such work as tunneling, trench digging, etc., some method has long been needed that would eliminate the necessarily slow hand picking and enable the work to proceed at a much faster rate.

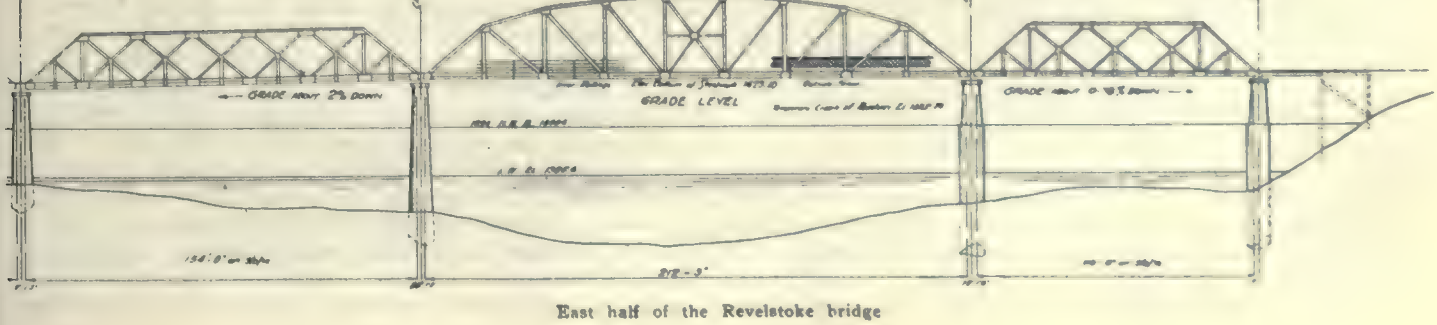
Compressed air through its adaptability for hand tool operation has again been found the most satisfactory means for reducing this tedious and costly labor. The blows of the air driven hammer have replaced the swing of the hand pick, here as well as in many another operation.

A type of these air driven clay diggers is shown in an accompanying illustration. The general construction of the tool is more or less evident from the picture, it consisting essentially of a long stroke pneumatic hammer, filled with a digging blade held in place by a retaining device. In operation the blows of the hammer drive the blade into the ground, prying loose the material so that it may be removed. The method of using these tools in stiff clay, is to slice the clay, as can be seen from the illustration.

The air hammer is an adaptation of a rugged type of tool that has proved successful, in the past, on work of a somewhat similar character—such as coal-picking, breaking out light concrete, corebreaking, etc. It should also be noted at this point, that this clay digger hammer is not limited to the employment of a digging blade only, but, that the latter may be easily removed and a bull point chisel substituted, if gravel, boulders or hard pan be encountered.

Amount of Work Increased

Records received from contractors using these tools, show that the amount of work done per man has been increased from 100% to 150% over the rate when the hand pick and shovel were used. Contracts



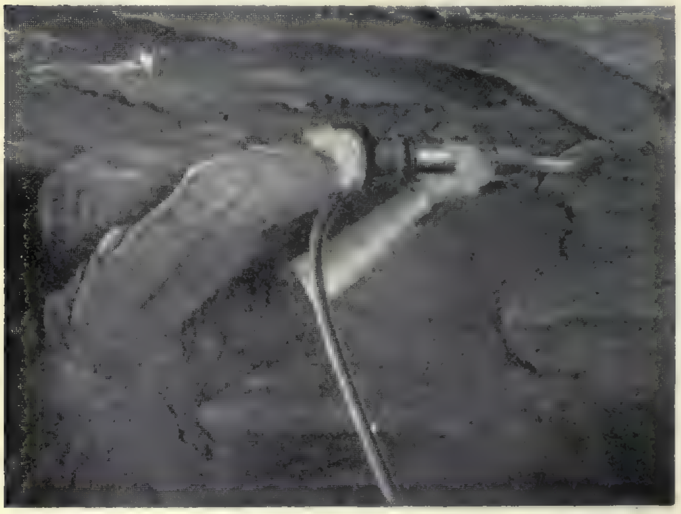
East half of the Revelstoke bridge

have been completed considerably ahead of time and at a very satisfactory profit by the employment of these air diggers.

Using old hand methods in tunnel work through clay, a man was able to move only from four to six cubic yards of clay per shift of eight hours, whereas with the aid of one of these pneumatic clay diggers, the same man could attain a rate of 8½ to eleven cubic yards for the same period of time. A rate of work has often been reached that has had to be limited because of inability to dispose of the muck as fast as it could be loosened.

Soil conditions encountered in the Detroit district vary greatly running from a very soft pumice like clay to very hard clay, and in between these extremes a great many things are met. For instance, in one section of the city, about two miles from the centre, clay of uniform, medium hardness, but full of sand pockets is encountered and requires very careful mining. Here the pneumatic clay digger proves of good advantage. By the old hand type of mining, using the monkey hole and power or hand knife, the work was hazardous on account of the danger of caving in. By using the pneumatic diggers the miner could feel his way along and timber when necessary to hold the top.

In another section less than a mile away, where a ten-foot six-inch diameter finished sewer is even now being built, the clay is extremely hard and no other method of mining has proved anywhere nearly as successful as the pneumatic clay diggers.



Air driven clay digger for tunnel driving

On this particular job they are using six diggers to the heading and are getting approximately eleven cubic yards per man per day; in other words, for the six men, approximately 66 yards for an eight hour shift. The best that they have been able to do without the air driven tools was four to six cubic yards per man per day. Under the most favorable conditions on this job the men have reached the surprising rate of sixteen yards per man per day.

Large Daily Output

On another nearby tunnel job just recently completed, the contractor averaged seventeen lineal feet of tunnel per day of eight hours with four miners (hammer men), the tunnel being approximately nine feet in diameter. This was an average of about eleven cubic yaards per man for each of the four miners employed. The material in this case was mostly a medium hard blue clay, which held up very good, no bracing or timbering being necessary to hold the roof. The conditions met with in this tunnel were of course also excellent, but the figures show what really fine results have been possible.

Incidentally, better ventilation in these tunnels was maintained because of liberated air from the exhaust of the tools. Even when the tunnels were driven in far from the shafts, good working conditions were secured by the exhaust without use of any fans or blowers.

On still another sewer tunnel of larged diameter in the same territory, an average progress of over fourteen feet per day has been reported. This tunnel was fourteen feet outside diameter. With four miners, four muckers and one car man, the tunned was driven forward, the distance stated each eight hour shift. The tunneling gang here was followed immediately by the masonry gang who put up the brick lining. Overhead conditions of course were fairly good so that the masons could follow along and place the brick work. Excavating was usually done during the day and the masonry at night. This meant that the passing of each twenty-four hours saw the completion of over fourteen feet of finished sewer.

Air Drying in Difficult Material

Another sewer tunnel, in which these compressed air tools were used, but under different conditions, was recently put through at Flushing, Long Island. The material encountered was soft clay, with streaks of hard pan, gravel and numerous boulders of various sizes. The digging blades were used to good advantage in taking out the clay while bullpoints were fitted in the hammers for working in the hard pan and around the boulders.

Because of the varying soil conditions, no accurate progress records were possible. Many large size boulders frequently obstructed the progress of the work, but they could usually be loosened and carried outside. One such obstruction, a six ton boulder, had to be "shot" before the work could proceed.

This tunnel was 9 ft. 3 in. in diameter, 2,000 feet long and was lined with segmental concrete blocks, seven to a ring. Firm support was required for the sides and roof so the contractors used a steel shield, pushed forward by hydraulic jacks as the work progressed.

Two pneumatic diggers were operated just ahead of the shield and lifter, there being usually only four to five feet of working space. Ordinary hand picks would have been very awkward to handle in such narrow quarters, and the air tools were found much more convenient and speedy.

As fast as the clay or hard pan was mined and mucked, the supporting shield was jacked forward and concrete rings build up. The inside diameter of the tunnel then became seven feet three inches.

It is interesting to note that on this tunnel job compressed air served for other purposes besides operating the shovels and promoting ventilation. Compressed air at 70 to 100 lbs. pressure was used to blow gravel behind the concrete rings immediately after they had been placed, filling up any empty spaces so that the rings at once helped to support the ground above. Suitable threaded holes cast in the concrete segments provided means for connecting the air lines. That this method was effective in supporting the overlying ground was evident, because at a later date no surface settlement was observed.

Grouting was accomplished in a similar manner by blowing in with air. This operation, however, was performed but once a week, when a series of rings were treated one after the other. An air motor was also used to drive a small mixer.

At the present time there has been completed in the city of Detroit, thousands of feet of sewer tunnel and thousands of feet are still to be driven. In the carrying out of these tunnel projects compressed air and the pneumatic clay digger apparently have become an indispensable part of the contractor's equipment.

It is worthy of mention that in this vicinity a number of contractors, being skeptical of the pneumatic clay diggers, went along for over a year without them. Practically everyone of them have now purchased and are using these diggers, having found that their use has cut the cost of doing the work at least 40 per cent.

Developments in the Methods of Constructing Brick Pavements

Certain Types Have Been Abandoned as Experience Has Proven Them to be Inadequate or Unsuitable—Lug Bricks Make Better Joints

Paper read before the eighth annual conference on highway engineering at the University of Michigan

During the past decade, the brick pavement has had an annual history of development. Paving brick have been manufactured in a great variety of sizes and types. Changes in methods of construction have been many and varied, some of which have been very unsatisfactory. Notwithstanding these conditions, the properly constructed brick pavement has remained a generally accepted type for use on trunk highways, subjected to intensive and heavy traffic, and for use on many classes of streets in municipalities.

The time is opportune to analyze the present status of paving brick and brick pavements, especially from the standpoint of types of paving brick and also because that leader of practice for many communities, the National Paving Brick Manufacturers' Association, recently has given material aid in the simplification of the paving brick situation and is now advocating the general utilization of an efficient method of construction.

In this discussion of brick pavements, only two important characteristics of an ideal pavement will be considered. It is generally acknowledged that satisfactory pavements must be durable and waterproof. A brief analysis of the several types of brick pavements will be considered from the standpoint of these two essential characteristics.

Development of the Brick Pavement

In the early days of the brick pavement construction, a sand foundation and sand filler were employed. This foundation proved inadequate for even medium traffic while the joints, being filled with sand, allowed water to pass through them to the sand bed below. A movement of the sand in the joints and bed naturally followed with the resulting displacement of the brick under traffic.

The first noteworthy development was the utilization of the cement concrete foundation, sand cushion and bituminous cement with which to fill the joints. These improvements indicated the application of sound engineering principles to the design of brick pavements. It was soon recognized that one essential feature of this method of construction was to utilize a bituminous cement which would adhere to the brick and would not be susceptible to changes in temperature to such an extent as to make it unsuitable for use as a filler. Unfortunately, some of the bituminous cement fillers employed had a tendency to chip or become brittle in cold weather and flow in warm weather. The results were unfortunate as the joints did not remain filled with bituminous cement and the exposed edges of the brick were chipped or broken off by the impact of iron tired wheels or horses' hoofs. Fortunately, however, many brick pavements were laid with joints filled with asphalt cement having the proper physical and chemical properties, including a minimum susceptibility to changes in temperature. In 1911 and 1912, the writer had the opportunity to inspect many sections of brick pavement, with asphalt filled joints, in municipalities in Indiana, Michigan, and Wisconsin. These pavements had joints filled practically flush with the surface of the pavement although they had been subjected to traffic for from five to ten years. The pavements possessed the desirable durability, while the surfaces were waterproof. This type of construction has continued to be used by engineers who are familiar with the best methods of constructing pavements.

Certain Types of Construction Abandoned

The next development was fathered by the National Paving Brick Manufacturers' Association. It consisted in the substitution of cement grout filler for the bituminous cement filler. After several years use of this method of construction, it was finally conceded that it was very difficult to secure uniformly filled joints by using cement grout and that a monolithic brick slab cracked, due to temperature stresses, thus enabling water from the surface of the pavement to reach the sand cushion, which gradually became displaced. It also became evident that the action of traffic on the weak sections of the pavement surface and on portions of the brick wearing course over the areas of displaced sand cushion caused many failures of brick pavements. These failures were due primarily to contraction stresses. Failures, however, occurred due to expansion stresses, such as the "blowing up" of sections of brick pavements.

The next developments were also introduced by the National Paving Brick Manufacturers' Association, one of the new methods consisting in laying the brick on a cement mortar bed resting on a cement concrete foundation and the other, laying the brick on green concrete. The joints in both methods were filled with cement grout. These methods are not at present promoted by the Association.

West of the Mississippi, the Western Paving Brick Manufacturers' Association has exerted considerable influence. The Association advocates the use of what is called vertical fibre brick with the rough surfaces uppermost and recommends that the surfaces be covered with a squeegeed coat of asphalt and the joints filled with asphalt cement.

At the last meeting of the National Paving Brick Manufacturers' Association, held on December 7 1921, the Association expressed "its confidence in asphalt filled brick wearing surface for street and highway paving properly designed and built with acceptable materials and thorough methods", and the Association further declared "its preference for the asphalt filled types of wearing surface" with the proviso that "preferment of the foregoing type of brick wearing surface for general use shall be without prejudice to any other type which may possess peculiar adaptation to special local conditions." In view of the fact that the Association has exerted a powerful influence over the practice of the construction of brick pavements in many sections of the country, it is hoped that, as a result of its latest recommendation, the durability of future construction in all sections of the country will not be jeopardized by the use of cement grout as a filler but that bituminous cements, possessing the desired characteristics, will be universally employed.

Asphalt Cement Fillers

In order to insure the use of a bituminous cement possessing the desirable practical minimum susceptibility to changes in temperature, the writer, in his private practice in northern states, has recommended, among other requirements, the following clauses covering the penetration of asphalt cement fillers:

Penetration at 25 deg. C. (77deg. F.), 100 grams, 5 seconds, 30 to 40.

Penetration at 4 deg. C. (39 deg. F.), 200 grams, 1 minute, not less than 15.

Penetration at 46 deg. C. (115 deg. F.), 50 grams, 5 seconds, not more than 85.

In order that the asphalt cement may be economically used to fill the joints, the writer advocates the use of conical pouring cans. The practice of squeegeeing asphalt over the surface of a new lug brick pavement is uneconomical, as a thin surface of asphalt is not an essential part of a properly constructed brick pavement. Whereas it may be practicable to secure good adhesion between asphalt cement and the rough surface of the wire cut sides of paving brick, the experience of the writer indicates that asphalt cement applied to the glazed surface of paving brick will usually peel off after being subjected to intensive and heavy traffic.

The present types of paving brick manufactured require careful consideration from the standpoint of the effiicient construction of durable and waterproof brick pavements.

Standardization of Paving Brick

A notable economic development resulted from the action of the Secretary of Commerce of the United States, Hon. Herbert C. Hoover, in calling a conference on the "Simplification of Variety and Standards for Vitrified Paving Brick" in Washington on November 15, 1921. This conference recommended the elimination of fifty-five out of sixty-six varieties of paving brick used in the United States. The eleven varieties which were retained include two sizes of plain wire-cut brick, two varieties of repressed lug brick, two varieties of vertical fibre lug brick, three varieties of wire-cut lug brick, and two varieties of hillside lug brick.

Leaving out of consideration hillside lug brick, eastern highway departments are primarily interested in the three types, plain wire-cut brick, repressed lug brick, and wire-cut lug brick. The two types of lug brick have been in successful use for many years and their inherent merits are well established. Many highway departments allow the use of either of these types under their specifications. It is well known that the utilization of lugs on the sides of these two types of brick is for the purpose of uniformly spacing in the laying of the brick in pavements and the providing of joints which can be filled satisfactorily.

In 1919, some of the manufacturers of vitrified paving brick began to manufacture a plain wire-cut brick. As a result of the United States Department of Commerce conference, two sizes of this type of brick will be manufactured, namely, three by four by eight and one-half inches and three and one-half by four by eight and one-half inches. As these bricks do not have lugs, it is apparent that two requirements relative to depth may be satisfied with one size of brick. For example, the three by four by eight and one-half inch brick may be used by highway departments which wish to lay brick with a four inch depth and also by those departments which wish to use a three inch depth.

Even spacing of Joints

Since the introduction of this type of brick, the writer has endeavored to determine its merits and the economy of its use. It is apparent that the following question would naturally arise. Will it be practicable to space the brick during construction so as to provide uniform and satisfactory joints? It was soon evident that the proper construction of a pavement surface of lugless brick would depend upon the ability of the pavers to satisfactorily and uniformly space the brick. Reports from contractors indicated that considerable difficulty was encountered even leading to the use of artificial means, such as the employment of an angle iron, to secure the desired joints in the brick surface.

Information relative to the results secured was so unsatisfactory that the writer decided to construct an experimental pavement in the laboratories of the Division of Highway Engineering and Highway Transport at the University of Michigan. The writer wishes to acknowledge his indebtedness to Professor John H. Bateman, Director, Michigan State Highway Laboratory, laboratory assistants and two engineers of the Ohio Paving Brick Manufacturers' Association for their kind co-operation in the construction of the test pavement.

The experimental pavement was constructed within a wooden frame, two feet six inches in width and eight feet in length, which rested on a cement concrete floor. A sand bed, one inch in thickness, was prepared upon which three and one-half by four by eight and three-quarters inch plain wire-cut brick were laid by one of the engineers of the Ohio Paving Brick Manufacturers' Association. The section was laid to conform with average practice on contract work. A Texaco asphalt cement filler, having a normal penetration of 33, was heated to 350 deg. F. It was poured by one engineer and squeegeed by another engineer of the Ohio Paving Brick Manufacturers' Association in accordance with the standard specifications recommended by the National Paving Brick Manufacturers' Association.

On several rows of brick, complete measurements covering the widths of all end and side joints were taken before the application of the filler. The measurements, expressed in inches, of the end joints of a part of a typical row follow; 1/16, 1/64, 1/8, 1/4, 1/8, 1/16, 1/64, 1/16, 1/64. The joints on one side of this row measured as follows, there being two measurements to each brick due to the fact that the bricks were laid to break joints in adjacent rows: 1/8, 1/4, 1/16, 1/16, 1/4, 3/16, 1/8, 1/8, 1/16, 1/8, 5/16, 3/16, 1/8, 1/32. The measurements on the other side of this row of brick were as follows: 1/8, 1/32, 1/16, 1/8, 1/64, 1/64, 1/64, 1/8, 3/16, 3/16, 1/4, 3/16.

Only Lug Brick Should be Used

With the approval of the engineers representing the Ohio Paving Brick Manufacturers' Association, the pavement was taken apart four days after it was laid. The depth of penetration of the asphalt cement on the sides of the brick was found to vary from 0.1 to 3.5 inches, the full depth of brick. The average depths of penetration on three sets of six consecutive bricks were 0.7, 1.2 and 1.6 inches.

The results obtained in the construction of the test pavement conform with the results which one might expect from the use of plain brick without some artificial means of securing suitable open joints. Even if some method, such as the use of an angle iron, was employed to secure uniformly spaced plain wire-cut brick, there is no guarantee that the brick would not be displaced during rolling prior to the application of the asphalt filler.

Considering the established fact that successful asphalt filled brick pavements may be constructed with repressed and wire-cut lug brick and that the use of plain wire-cut brick is accompanied with great risk relative to securing well filled joints, the writer is of the opinion that conservative practice dictates that only lug brick should be employed. From the standpoint of the economics of construction, the use of the plain wire-cut brick is not justified. There is no indication at present that there is any material difference in the price per thousand of the lugless brick and the lug brick. Furthermore, granted an increase in cost of lug brick over lugless brick, the excess cost of lug brick is a good investment from the standpoint of insuring the construction of a durable pavement with the joints properly filled with asphalt cement.

Relation of Motor Trucks to Highway Construction and Maintenance

By J. G. McKAY
Professor of Economics, University of Wisconsin

Before American Road Builders' Association

The true purpose of an improved highway is a high degree of transportation service at the least possible cost to the public and road user. Clearly a traffic census is not a panacea, but I insist that without a knowledge of the actual traffic, speed, type and weight of a given area, we are working in the dark. The actual traffic in terms of volume, density, speed and unit weights, must be correlated with laboratory and experimental impact tests as a guide to rational design. Independently each type of research is valuable, but the true worth of both cannot be realized until combined—in other words, interpreting the results of laboratory experiment in terms of vehicles on the highway.

Our investment in highway systems is constantly increasing. The investment in motor vehicles and the automotive industry is constantly growing steadily. A careful analysis must be made of the chief traffic elements responsible for increased construction and maintenance costs before the enactment of legislation which may, while protecting the highway, prove injurious to the growth of a highway transport service, and detrimental to the automotive industry.

Must not be too Ready to Limit Loads

We must be certain of our facts before we limit the traffic which may pass over any given highway. The limitation of wheel and gross loads must be based on definite information. The rapid destruction or ruin of gravel or macadam, and even concrete construction under heavy traffic does not necessarily mean that the construction of more durable pavement types is essential. It is conceivable that the heavy freighting vehicle is not an economic unit load, and that ultimately a smaller unit will become the maxmum.

In making comparisons of the economies of the different methods of freight movement we are prone to make comparisons on the basis of operating costs alone. The true haulage cost must be based not only upon the cost of operation of the vehicle, but also a portion of the cost of building and maintaining a highway for the movement of vehicles, and must be included as a cost charge. Naturally this cost increases rapidly as the unit loads increase. Saving in transport costs may occur when heavy vehicles operate, reducing the freight costs by a few cents per ton mile. On the other hand a decided economic and social loss arises when ne wroads must be built, or maintenance costs are excessive, due to the utilization of the highway by heavy vehicles. The savings in operating costs of a few cents per ton mile are more than offset by the heavy construction and maintenance charge. It is not alone a question of cost, but the road is out of service which is even more serious.

It may be that an increase of the tire width per capacity of trucks to carry the freight load without destruction of the pavement is the solution. It is possible that the tire equipment should be capable of carrying the entire load, as suggested by Mr. Otto Armleder, manufacturer of Armleder trucks. This would solve the problem of overloading on the rear axle, but not reach the problem of the unit weight on the pavement, or overloading on the front axle. A study of the comparative economies of 3, 5 and 7-ton trucks with regard to highway construction and maintenance, vehicle operation costs, and service time, would settle this controversial point and determine the maximum economical load unit.

Tendency to Restrict Loads

Today we see a strong tendency in the direction of restrictive legislation limiting the total loads which may pass over our highways and bridges. The classification of a highway system which limits the gross weight to 12½ tons on a very small percentage of the roads, and to 7½ tons on the balance of the system, definitely limits the manufacturer of trucks to a limited area for the sale of heavy vehicles. It is to his own best interests to co-operate in the solving of his difficult problem in order that his market may not be restricted beyond reasonable limits. The establishment of weight limits per inch of tire width must be based on conclusive evidence and research.

The manufacturer of trucks cannot afford to design and market vehicles which unduly increase the cost of construction and maintenance of our highways. The highway engineer cannot afford to build roads that will cripple or limit unduly the hauling capacity of trucks. There is a joint enterprise, a movement of the maximum traffic at a minimum cost, and upon its successful solution rests the welfare of both the public and the vehicle manufacturer.

Truck Transportation and Existing Transport Systems

It is an open question whether or not the ultimate sphere of motor truck operation is to be competitive with or supplementary to our existing transport system. The consideration of this problem carries with it far reaching consequences, beyond the mere comparison of the cost of movement of freight by one or the other type of carrier. The movement of freight is by nature monopolistic, and does not permit of true competition. Either one or the other type of transport will occupy the field. The junking of our railroad investment would involve the destruction of property rights representing approximately one-twenty-fifth of our national wealth.

We must consider the relative difference in the investment comparing a large railroad system, with strict governmental regulation of rates and service, with fleets of motor vehicles in which the investment of the owner is small, with an absence of rate regulation or guarantee of service. The railroad investment is permanent and cannot move to an alternative field, it must operate or become a loss. The commercial vehicle operator, however, may move to alternative fields when profits fail. This naturallly would endanger the guarantee of freight service which is a more fundamental question than cost.

It is difficult to conceive of the movement of heavy freight of low value by truck transport. The cost of moving such products as coal and iron, practically limits the commercial truck field to high value and low bulk goods. Can the railroads operate profitably moving the low value and large bulk commodity goods on the short haul, while the profitable business is absorved by the motor vehicles? Any comparison of the two types of transport with a view of selection of the more economical type involves a comparison of costs. In such an analysis we must not forget that the cost of construction and maintenance of the road bed in both cases, is a part of the charge which must be made against the freight moved. A proper share of construction costs and maintenance costs of the highway must be paid by the truck operator, before a real comparison of rail and truck rates can be made.

A clear analysis of all the factors involved must be made before we can determine whether the field truck operation as a carrier is to be competitive or supplementary to existing transport systems.

Unprejudiced research is fundamental in the attempt to solve these many difficult highway problems. Supply definite information to the highway engineer with the assurance that the type and weight of traffic will not change over night, and he will build safe and permanent roads able to carry the traffic at a cost not exceeding the service value of the highway to the community. The vehicle manufacturer in all fairness is entitled to know the facts upon which he must design and build trucks which will meet the requirements of a constantly increasing highway legislation.

In approaching an analysis of some of the factors involved in highway construction and maintenance, and motor vehicle movement, a clear picture of the traffic passing over a given highway is essential to a thorough understanding of the type of construction necessary to traffic of a given type, giving at the same time a definite idea of the regularity of motor vehicle movement, density, weight and produce.

Value of a Traffic Census

A traffic census may be defined as "a complete summation of traffic passing over the highways of a given area during a definite period of time." Every traffic census has certain limitations and a traffic census based on the following plan has the following limitations:

A certain portion of the traffic over newly completed roads consists of "attracted" traffic from other routes and does not represent the true traffic which will ultimately pass over the particular highway observed. Allowance must be made for a redistribution of traffic when parallel highways of the complete system are constructed.

We cannot expect that a summation of vehicular movement will accurately portray future traffic. To obtain a picture of future traffic the census must be taken at given intervals over a period of years to determine the percentage increase of each vehicle type. The potential traffic of a given area to supplement the actual traffic census may be obtained by a survey of the agricultural and industrial growth of the community.

Only in a general way will the census data answer the question of the influence of various types of traffic on the highway without maintenance studies of the same road, correlated with impact studies. To be able to interpret correctly the weight and volume data, accurate maintenance cost studies are essential. It is advisable in the selection of traffic census stations to place them on highways on which maintenance costs of the various types of pavement are kept.

The tonnage volume and weight per capacity of various vehicles will be of more value when combined with impact studies showing the effect on different types of pavements by impact tests. Being given the result of impact studies on the several road types, produced by the different vehicles, as shown by the census, the construction engineer can be assured of the type of highway he must build to carry the traffic. This will prevent over or under-construction with the economic wastage occurring in either case.

In the past, traffic censuses have been taken by highway departments largely for the purpose of determining the number of vehicles, passengers and types to indicate numerical movement. Generally such survey occurred during density of movement and for short periods of time. In a few cases the period of the survey was longer, while in one case actual weights were recorded.

The Purposes of a Traffic Census

In the belief that the expense of taking a traffic census should produce more than surface results, and that the importance of the problems involved call for definite information, the following outline of traffic census is evolved.

The main purposes of a traffic census may be summarized as follows:

An aid in determining the economic value of a highway. Three principal factors enter into the valuation of a highway improvement. The increase in land values, highway service value in terms of passenger and freight ton miles, and the general value to a community. The only method of obtaining passenger and freight ton miles is by means of a traffic census for a definite period translated into yearly traffic.

Classification of vehicular traffic. A classification of traffic of the several types is useful in formulating traffic regulations, and to some extent in formulating the percentage source of revenue from highway users in accordance with their actual use of the highway.

To determine gross truck weights and overloading per truck capacity. Weight and speed are guides to design, pavement selection, limitations of grade and alignment. The facts as to overloading per capacity can only be determined by a knowledge of front and rear axle distribution of weight in terms of loads per inch of tire width. It is not merely a problem of loads beyond a given maximum, but the real difficulty lies in overlooking beyond truck capacity.

Distribution of construction and maintenance funds. To distribute maintenance and construction funds in a fair proportion to traffic, we must know the volume and type of traffic on the different highways. The greater the volume of traffic, logically the greater the per cent of construction and maintenance funds allocated.

To determine density and truck body widths. The peak of traffic hourly, daily and during the season is essential. Peak density and speed influence width of pavement and determine the maximum width necessary to carry the peak load. A direct ratio exists between vehicle body widths and pavement width. Pavement width increases with the increased speed movement of the vehicle, particularly when the load is heavy.

Seasonal and yearly traffic volume and density enable a prediction in a general way of future traffic.

Vehicular Movement of Freight

To determine the vehicular movement of freight. Information as to regular and irregular trucking lines throws light on the proportion of regular freight movement. This is particularly valuable in the industrial states of the east and northeast. The average length of haul of commercial freighting indicates the field of competition of the truck and railroad, whether the short or long haul. The type, volume and value of commodities moved indicate the commodity competition and the per cent of high value and small bulk freight moved as compared with low value and large bulk freight. The average delivery time indicates the rapidity of movement of commercial freight service.

Information relative to truck operating costs and freight rates does not properly lie in the field of a traffic census, but must be made through independent studies.

Average speed of vehicles. These data must necessarily be obtained at the same time the census is recorded to check each vehicle observed in the speed test with the data obtained at the census station. The recording of the license number in each case permits the determination of capacity and weight. This information is useful in the formulation of speed regulations and their enforcement.

Bases of the formulation as to weight, overloading, tire condition, body widths and speed not only afford a reasonable basis of traffic regulation, but is the data upon which enforcement depends.

The past few years have witnessed a tremendous growth of new highway construction and the volume and types of vehicles using our roads. The interests of the highway engineer and the producer of motor vehicles are largely the same—the one to construct and maintain highways which will carry a maximum of traffic of economical weight units at a minimum cost; the automotive manufacturer to produce vehicles which will move the traffic at a minimum cost and with the least damage to the highway. We cannot afford the waste of building roads to carry all types of traffic and unlimited loads, nor can we fit the vehicle to all types of highways. It is a combination of both, the building of suitable and satisfactory roads, and motor vehicles of the proper construction and weight. This is a joint industry of the road maker and the road with a common object, the production of transportation at a minimum cost.

Many Problems

Naturally in any industry whose growth has been as rapid as the development of our highway system, abuses arise. Difficult problems develop upon whose successful solution rests the continued support of public approval. We have at present in the highway industry, many unsolved problems of highway economics and engineering which require immediate consideration. Intricate problems of finance, transportation, valuation, construction and maintenance, are a constant challenge to research in the field of high economics. This is a major field of operation and calls for the mutual co-operation of all people interested in seeing the creation of permanent and continually usable roads at a minimum of expense.

One of the most serious difficulties confronting the highway engineer today is the construction of roads which willl remain in existence long enough to justify the investment, and at the same time withstand the hammering of the steadily increasing volume of weight to which the pavement and subgrade are subjected. This presents a two-fold problem. First the problem of excessive loads above a given maximum weight which results in the premature destruction of the highway. In 1920 only 1 per cent of the motor trucks manufactured were over 5 tons capacity. The California Highway Commission in a recent statement says: "As the ratio of use must be in close proportion to the ratio of production, it follows that only about 3 per cent of the vehicles using the

California state highways are the so-called heavy duty type. Highway construction, like any other governmental activity, is based on public necessity and this necessity should be met reasonably when highways are built, adequate to sustain 90 per cent of the traffic. This percentage would include all motor vehicles, including the 2-ton capacity. Assuming $30,000 per mile as adequate to sustain 90 per cent of the vehicular traffic of the state and $50,000 per mile to construct a highway which will sustain the weight required by 10 per cent of heavy duty trucks, should the general taxpayer be required to invest an additional 66 per cent in road construction for the primary benefit of this particular call of heavy vehicles?"

We must fully recognize the necessity of automotive transportation, and the need for construction which will carry modern traffic, but first we must determine the economic load units, and second eliminate overloading. The weight of single units and speed are the two essential points of difficulty. The greater the speed of heavy loads the more damage to the highway. The ratio of damage to the road with an increase in speed is altogether out of proportion to the economies gained by faster movement.

The fact that pneumatic tires are found on the smaller capacity vehicles should seem to eliminate the use of the pnuematic tire as a solution. Reduction of speed, elimination of overloads, and restriction of gross tonnage and an increase in depth and width of solid tire equipment will reduce highway damage.

Load Classification of Roads

The majority of heavy movement occurs on our trunk highways usually between industrial centers. There is, however, some movement of heavy loads on our secondary highways and generally the result is ultimately the destruction of the highways. Under adverse weather conditions, a single trip of a heavy load over roads built to carry light traffic results in its destruction. An example of what may occur was shown during the "ship-by-truck" week a little over a year ago when an attempt was made to relieve the railroad freight congestion. The destruction of highways unable to maintain heavy traffic more than offset by many millions of dollars the economies which resulted by relieving the railroads of their freight congestion.

It is not contemplated that we will ever construct our secondary highways to carry the maximum loads imposed on our primary roads. To prevent the destruction of our secondary systems by heavy trucking vehicles and loads, a classification of highways is necessary limiting maximum weight of vehicles moving over each road classification. The Wisconsin Highway Commission recently put into operation a classification of highways with the object of regulating track weights on its trunk highways and secondary roads. Class A roads limit the loads to 12 tons, while class B roads limit the load to 7½ tons. The majority of Wisconsin highways, primary and secondary at the present time, fall under class B. Class A roads consist of the more durable construction types, while class B consists of the less durable types. Strict supervision of the weights of vehicles using the highway, and severe penalties for violation of such a classification are essential in order to compel obedience to the law regulating the maximum and capacity weights which may move over each class of highways.

Regulations as to gross weight and overloading must take into consideration two road factors. First, the difference in road types, permitting heavier gross loads, and loads per inch of tire width on the more durable types, limiting both gross load and weight of wheel load on less durable types. Second, in those localities in which there are considerable climatic variations, restrictions should be imposed during the early spring, when the pavement is more easily destroyed than later when the frost has disappeared and the road is not susceptible to injury.

The second phase is the problem of overloading per truck capacity. My analysis deals primarily with this problem, which is by far the most serious. The limitation of loads to a maximum of 25,000 lb. does not prevent the overloading of trucks whose rated capacity falls below the maximum load provision.

In Connecticut censuses, which I conducted at each of the stations, the width of tire was taken by measuring the impression made by the wheel load, front and rear, after passing over strips of impression paper. The front and rear axle weight was procured in order to determine the total load, and distribution of load, on the front and rear axle. These figures enabled me to determine the wheel load per inch of tire width for each truck, make and capacity.

Limitations of Analysis of Overloading

Any analysis of overloading has certain limitations in the present state of highway research. (1) The lack of maintenance cost studies of the highways on which the surveys occurred, does not permit of establishing accurately the direct relationship which exists between overloading per capacity and high maintenance costs; (2) the effect of overloading on the pavement and subgrade can best be shown when correlated with impact studies of the several pavement types; (3) criticism of the overload data on the basis of the standard used in determining overloads. The weight standard used to determine overloads for each make and capacity consists of a summation of the manufacturers' 1920 weights for the chassis, body, and rated capacity, giving the total weight when loaded to capacity. The percentage distribution of weight recommended by the manufacturers of trucks for front and rear axle load is used as a standard for determinating overloads on the front and rear axle. In order to be conservative 5 per cent of the total chassis, body and capacity weight was added to the manufacturers' given weight and used as the standard for computing total overloads per capacity. One-half of this 5 per cent was added to the front and rear axle standard weights in arriving at overloads for the front and rear axle.

Building Materials Situation

The past week has seen few changes in the market for building material in Toronto. Shingles fluctuated a little, the best grade XXX B. C. cedar advancing 50 cents per M, while the second grade or XX B. C. Cedar dropped 50 cents per M. Turpentine has reached the highest figure for some time, being now quoted at $1.45 per gal. Raw and boiled linseed oil dropped 5 cents per gal. during the past week. The brick shortage is general, the best delivery offered being about two months. The common or backing type of brick is, perhaps, the scarcest, due to the small stocks generally carried by the manufacturers.

Wood Pipe and Tar Pipe Coatings

Abstracts of Two Papers Read Before the American Water-Works Association at Its Recent Philadelphia Convention—Abstracts Made by Engineering News Record

Some Observations on Wood Pipe

By J. W. LEDOUX
Consulting Engineer, Philadelphia, Pa.

For all ordinary sizes of pipe it is generally recognized that the present standard is cast-iron pipe. For water purposes there is more cast-iron pipe used than all other pipes combined, the reason being that cast-iron pipe can be made absolutely tight under all circumstances and will remain so under all variations of pressure. For very large sizes, however, it is too costly as compared with wood or steel, and under many situations the reduction in capacity due to tuberculation is so serious that engineers will prefer a reinforced-concrete pipe or wood pipe.

Undoubtedly in regard to extensive use, wood pipe comes next to cast iron. It may be conservatively stated that cast-iron pipe will last one hundred years. Although there are many modern wood pipes that have been giving good service longer than 25 years, when we compare wood with cast-iron it is best to assure a short life for the wood pipe.

Comparative Cost of Wood and Cast-Iron Pipe

As an example, let us take 24-in. continuous redwood and assume a life of 25 years. Say the wood pipe will have to be renewed four times in 100 years and cast-iron pipe will last indefinitely. Let us take the average discharging capacity for the wood pipe as 20 per cent greater than that of cast iron. Table 1 shows the details and result of a cost comparison, computed on the basis of present worth. [Table 2, showing various comparative data on the cost of wood and cast-iron pipe is also reprinted here. The original paper contains many data on wood pipe design, both as to banding and hydraulic calculations.—Editor.]

For machine-banded eastern pine (also 24 in.) the initial cost would be $28,900 as against $41,900, but after making the same calculations as are shown in Table 1 the present worth figures obtained for wood pipe would be $50,125 and for cast-iron pipe $86,650, a saving of $36,525.

For 12-in. machine-banded eastern pine pipe the initial cost would be $14,900 for the wood pipe and $26,900 for the cast-iron pipe, making the same calculations as before, the present worth of the total cost of the wood pipe would be $25,847, and of the cast-iron pipe $34,027, or a saving of $8,180, 28 per cent of the initial cost of the cast-iron pipe.

Why is Cast-Iron Pipe Generally Preferred?

When a financial comparison on a rational basis shows such a material advantage of wood over cast-iron pipe, the question naturally arises, why is cast-iron so universally preferred by most of the leading engineers? It is, no doubt, because there have been so many unfortunate experiences with wood pipe.

From our knowledge of water pipe, it may be said that the best pipe that could be obtained for any purpose would be cast-iron with some sort of non-corrosive and indestructible inner lining, but in ten years from now, this statement may be obsolete, and the writer is of the opinion that we are on the eve of great and fundamental improvements in water pipe manufacture. However, it is believed that it will be many a decade before the use of wood pipe will be unwarranted. At present it is in use by at least 500 municipalities and water companies scattered throughout the United States.

TABLE II—COMPARATIVE COST PER FOOT INSTALLED OF WOOD AND CAST-IRON PIPE FOR 65-LB. PRESSURE

Nominal Diameter In.	Machine-Banded Wood Pipe Pine	Machine-Banded Wood Pipe Redwood	Machine-Banded Wood Pipe Fir	Continuous Wood Pipe Redwood	Continuous Wood Pipe Fir	Cast-Iron Pipe at $44 Per Ton
6	$0.96	....	....	....	....	$1.26
12	1.49	....	....	....	....	2.69
20	2.29	3.70	3.27	3.43	2.92	5.21
24	2.89	4.84	4.31	4.19	3.58	6.71
30	4.13	....	....	5.27	....	9.13
36	....	....	....	6.35	....	12.02
48	....	....	....	9.50	....	18.90

Trenching is for all kinds of pipe taken as follows:

6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
$0.37	0.52	0.76	1.00	1.15	1.40	2.00

The following weights of pipe are taken in pounds per lineal feet:

	6-In.	12-In.	20-In.	24-In.	30-In.	36-In.	48-In.
Machine banded pine. .	15	22	38	49	85	...	...
Machine banded fir.....	..	..	37	40	...	...	...
Continuous redwood....		..	35	44	60	76	115
Continuous fir.........	..	..	38	48	66	83	125
Cast iron..............	31	76	160	210	300	407	660

Hauling taken at $2 per Ton.

Discussion: J. E. Gibson, Charleston, S. C., said he did not think Mr. Ledoux had taken into account the cost of digging up improved pavements for the replacement of wood pipe, which would eat up the savings effected by the use of wood. Charleston has a large mileage of continuous wood stave pipe and some machine banded wood. It is going to lay five miles of 6 to 16-in. cement-lined cast-iron pipe. The reduction in diameter caused by the lining will be nothing like that due to tuberculation which soon comes back after cast-iron pipe is cleaned. John Cheater, Pittsburgh, Pa., said it is now impossible to get white pine suitable for wood pipe and that he would not want to use spruce. He was against using wood pipe in distribution system. He did not like to see wood put under pavement.

TABLE I—SAVING BY USING WOOD RATHER THAN CAST-IRON PIPE

	Wood	Cast Iron
Initial cost of 24-in. pipe..................................	$41,900	$67,600
Increase in cost of cast-iron pipe to obtain 20% increased capacity..	....	6,450
Initial cost for equal average capacity...	$41,900	$74,050
Annual Charges:		
Wood pipe—repairs 1%, taxes 0.6%	$670	....
Cast-Iron pipe, repairs 0.25%, taxes ..6%.................	....	630
Present worth of $41,900 at 5% for renewal in 25 years.......	$12,373	....
Present worth of $41,900 at 5% for renewal again in 50 years	3,654	....
Present worth of $41,900 at 5% for renewal again in 75 years	1,079	......
Present worth of $41,900 at 5% for renewal again in 100 years	319	....
Present worth of $670 per year for 100 years at 5%..........	13,400	....
Present worth of $630 per year for 100 years at 5%..........	....	12,600
Initial cost for equal average capacity.....................	41,900	74,050
Total present worths...	$72,725	$86,650
Saving (about 20%)...	14,488	... ...

Present Day Tars for Pipe Coatings

By W. R. CONARD
Inspecting Engineer, Burlington, N.J.

When Doctor Angus Smith got out his process for coating cast-iron pipe, coal tar was a residue of the manufacture of gas from coal, just as it is today, only in those days the many by-products to be obtained from this residue were apparently little known, and the tar was what is termed "virgin tar." Could the good Doctor have foreseen some things, such as by-products, tar from oil and water gas sets, etc., it is probable that he would have given much more detailed specifications, and placed many safeguards around the coating.

The present standard specifications follow somewhat the Smith specifications, but although they call for coal tar pitch varnish the material actually used is not pitch nor is it varnish as those terms are generally understood. Moreover, the kind or kinds of oil to be used "to keep the mixture at the proper consistency" and the proportions are not definitely stated, nor is needed provision made for variation in season and weather.

Composition of Tar

Average coal tar is made up of carbons, oils, acids and gases. The acids and gases are in the forms of hydrogen, oxygen, nitrogen and sulphur. Its main body is carbon and it is the carbon held together by the oils which protects the metal from corrosion, and it is the acids that tend to attack and corrode. Therefore, it is desirable to get for pipe coatings a tar as free from acids as may be, and as high in carbon and oils, especially the heavier oils, and to use the coating at temperatures that will not evaporate the oils.

Coal tar and its by-products are put to a wide variety of uses. The heavier material usually called tar (no matter how much it has been distilled or refined) is used for paving, road work, the various forms of roofing materials, etc., while the lighter part is used in many lines of industry, particularly the chemical, so that the value of coal tar is greater for refining purposes than in its crude state, which condition is the best for pipe coating purposes. The result is that unless the pipe maker controls some source of production, he has to compete with the refiner, with the consequence that there are times when he gets left, and the pipe purchaser is the innocent sufferer.

While the pipe maker specifies and tries to get virgin tar, I believe that the tar he does get does not contain as large a proportion of the heavy mineral oils as the tars of Angus Smith's time contained, so there are cases where the coating is not as durable as it once was. It seems possible that even using coal tars that have had their by-products extracted together with some other material or materials, whether oils or some other form of binder, a better and more durable coating than at present can be found. I would not say to disregard tar entirely for as I view it there has not yet been found anything that could within economic limits take its place, but I do not think that the virgin tar of today is the last word in pipe coatings, and I do not think thorough research would develop some other material to put with tar that would form a much better protection to iron and steel pipe surfaces than we are now using.

Coating Not Impervious

From what I have observed of pipe which have been in service, it is my conclusion that the coating on the pipe is not impervious to moisture, having small pores which usually extend through the coating. This allows the moisture to get to the metal, whereupon ferrous oxide forms, comes out through these pores and spreads over the interior of the pipe. There is need to see whether there is something to use with the tar that will seal the pores. Also, I believe that investigation should be made of whether pipe of different sizes and classes should be dipped in the tar bath at different temperatures, for the volume of the metal in the pipe controls the number of heat units to be thrown off before the coating sets, and as long as the heat prevents the setting of the coating, the heat will also continue to evaporate the oils in the tar and tend to leave nothing but dead pitch.

As to what materials might be used in conjunction with tar to prevent the forming of iron oxide, these things have occurred to me. One is the coating especially of the interior of the pipe, with some parrafin substance before applying the tar; this was suggested by S. B. Brown of Warren Foundry. The other is the use of some substance that has no oil or gas-forming constituent, but is very dense and, when set, impervious to moisture, which will become fluid at approximately the same temperature as tar, and will mix with tar readily, and can therefore be put in the tar tank, and applied in conjunction with the tar. And still another might be to find some means of getting a much thicker coating on the pipe, which would stay put, and not tend to scale in cold weather, and run in hot weather.

Mussens Limited, Montreal, Celebrate Their Coming of Age

(Continued from page 556)

these things as they face the problems of the future and enter upon a period of reconstruction and opportunity which we all trust may bring our native enterprise to fuller fruition.

To the Contract Record & Engineering Review it is an especial pleasure to render unto Mussen the things which are peculiarly Mussen's on the fifteenth of June, seeing that the activities of the paper and those of the Mussen organization have proceeded on parallel lines for many years. The full-page advertising announcements of Mussens Limited, have appeared regularly in this paper far beyond the recollection of any but the oldest readers, dating back to the infancy of The Contract Record, when the editorial contents were confined mainly to The Contracts Department—before the paper even boasted a cover!

As the June fifteenths come and go, may each succeeding year bring to Mr. Mussen and his associates its own particular reward for a very considerable contribution to the business stability and reputation of a great industry.

To twenty-one years of honorable effort The Contract Record pays tribute.

The consulting engineering firm of James, Proctor & Redfern, Toronto, are building a small hydro-electric plant for the town of Thessalon, Ont. The plans call for a 200 h.p., turbine and generator, with three miles of transmission line. The power will be used for lighting and for operating the water works pumps. Tenders will be called shortly.

The Contract Record's

Weekly House Suggestion No. 22

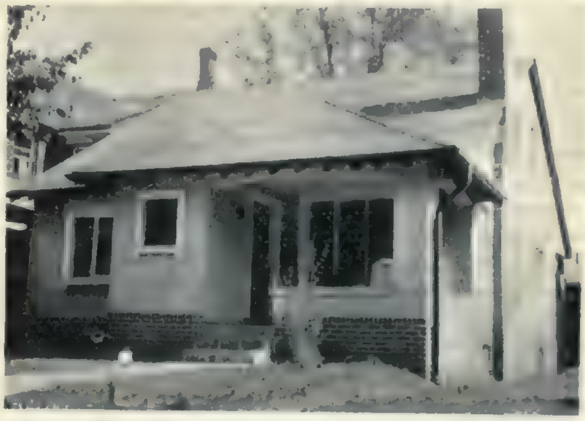
The general construction of the attractive little home, which is the subject of this week's article, is hollow tile with stucco facing from the base course up, the foundations being of brick. It was built for Mr. W. H. Smith, on Blythewood Road, North Toronto, recently. The verandah and vestibule arrangement, as seen in the accompanying illustration is out of the ordinary and plays a big part in the neat, attractive exterior appearance of this residence. Best grade XXX B. C. cedar shingles were used for roofing and all windows are of the casement type, with large French windows on the living room and main bedroom at the front.

The trim of the first floor is of pine throughout, finished with white enamel and the floors are of birch, with the exception of the bathroom and kitchen which are of pine. There are four large rooms on the first floor, living room, dining room, bedroom and kitchen, also bathroom. There is a direct entrance from the vestibule at the front on the living room which contains a brick mantel with built-in bookshelves on either sides. A glance at the layout of the ground floor suggests careful attention to the factors of convenience and conservation of space on the part of the designers. The bathroom and kitchen contain built-in cabinets and shelving and the latter room is thoroughly wired for lighting and electric utility services.

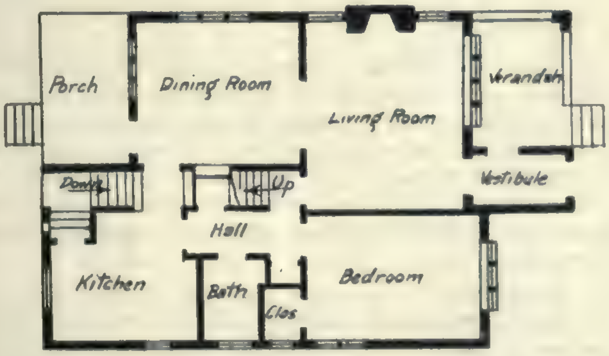
There are two large bedrooms on the second floor, which is also finished in pine throughout, white enamel trimmed.

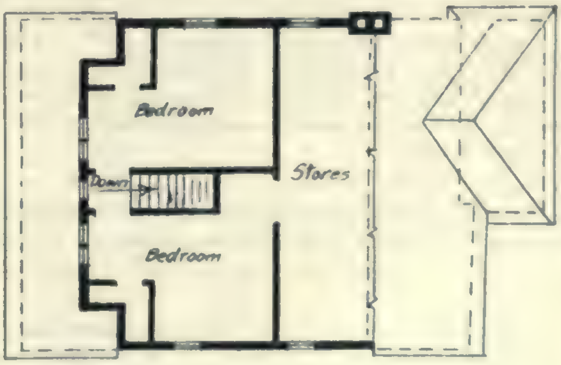
The basement is under the entire area of the house and contains laundry, storeroom, coal room and heating plant of the hot water type.

There is a single car garage at the rear of the house, of timber construction, painted brown to harmonize with the exterior decoration of the house.



Messrs. Molesworth, West & Secord, architects of 43 Victoria St., Toronto, are the designers of this residence.





Mainly Constructional

East and West—From Coast to Coast

Hon. Mr. Perron, Minister of Highways, province of Quebec, recently claimed, it is stated, that it will be possible for the province to construct 45 per cent. more roads this year than last, for the same expenditure.

The A. D. Porter Manufacturing Co. Ltd., has acquired a plant on Hobson St., Galt, Ont., and is installing machinery for the manufacture of steel and brass products for the plumbing trade, specializing in brass bands. It is the company's intention to install machinery at a later date for the manufacture of shoemaker's hardware and hardware for the furniture trade.

According to a recent announcement, Halifax has been chosen by the War Graves Commission as the site for a national monument to Canadians lost at sea through hazard of the war. The monument will be of the type of the Bloomfield Cross of Sacrifice, and will be erected in Point Pleasant Park, on an elevation facing the sea.

The difficulties between the carpenters and the employers at Toronto have been settled, the men having all returned to work at the old wage of 90 cents per hour pending arbitration. The men went out in protest against an attempted reduction of wages to 80 cents per hour.

Several changes in the directorate of the P. Lyall & Sons Construction Co. Ltd., of Montreal, took place at the annual meeting of the company held recently in that city. The present officers are as follows: William Lyall was again named president, while T. O. Lyall becomes vice-president and treasurer, succeeding J. B. Caine, resigned. J. N. Greenshields, K.C.; H. W. Beauclerk and H. M. Scott continue as directors, while James Ballantyne was named in place of C. H. Allen, and Robert Whyte, who has been acting as secretary of the company and will continue in that position, was elected a director in the place of the late E. W. Wilson.

The work of repairing Toronto's 33,000,000 gal. water reservoir at Rosehill Park has been completed and the huge tank has been filled again. The work consisted mainly of replacing the inadequate 24 in. main with a 36 in. main, but opportunity was taken while the tank was empty to give it a thorough cleaning.

Building in Windsor, Ont., for the first five months of 1922 has passed the $2,000,000 mark, according to permits issued by Robert Parker, building inspector. During May 189 permits were issued for a total estimated cost of $417,205, while in May, 1921, 138 permits were issued for a total estimated cost of $600,384. Home building was responsible for $322,000 of last month's total, ninety-one permits for residences being issued.

Following a brief debate in the U. S. Senate recently, it was decided to allow the importation of common brick, manufactured in Canada, free. There is a strong movement, also, it is said, to lower the existing tariff on other types of brick.

The re-modelling of the Lyric Theatre at Hamilton, Ont., is being planned, which will make it one of the finest vaudeville theatres on the continent. The sum of $100,000 will be spent on this work, which will cover practically the entire rebuilding of the interior and the erection of an elaborate entrance foyer.

The fair wage list that will be in force on Montreal civic contracts this year was announced on June 5. It names the wages that contractors doing work for the city must agree to pay their men. This list is as follows: bricklayers 80 cents an hour, carpenters-joiners, 65 cents; carters (single), $5.00 a day; carters (double), $8.50 a day; electricians, 70 cents; sheet metal workers and roofers, 60 cents; asphalt finishers, 50 cents; cement finishers, 60 cents; blacksmiths, 65 cents; bottom men (drains), 40 cents; asphalt rollers, 50 cents; big-roller (macadam), 45 cents; engineers, 50 cents; engineers, stationary, 50 cents; laborers (common), 35 cents; lathers, 60 cents; masons, 75 cents; workmen, 37½-40 cents; cement levellers, 45 cents; pavers, 55 cents; painters, 60 cents; weighers, 35 cents; plumbers, 75 cents; plasterers, 75 cents; steamfitters, 75 cents; curb and flagstone setters, 55 cents; tile setters, 60 cents; asphalt rakers, 55 cents; stone cutters, 75 cents.

Personal

Mr. Samuel McClure, former county road superintendent of Carleton County, Ont., is reported as being very ill at his home in Fitzroy Township.

R. J. Sandover Sly, civil engineer of Campbellton, N. B., has been appointed town engineer of that municipality. Mr. Sly's appointment also includes the offices of plumbing inspector and manager of the Water and Sewerage department of the town.

Mr. Walter S. Allward, well known Toronto sculptor, left that city recently for Vimy Ridge where he will be engaged, it is expected, for the next five years on the Canadian memorial. The memorial will cost $1,000,000 and will be 130 ft. in height.

Mr. N. H. Bradley, of the Dominion Department of Public Works, has been appointed chief engineer of the Peace River District, with office at Edmonton, Alta. Mr. Bradley was formerly located at Lethbridge, as assistant engineer for the department in that district.

Mr. G. Henry, chief engineer of the Department of Roads, Quebec, has been elevated to the position of consulting engineer and his position has been filled by Mr. M. Neckar, of Montreal. Mr. Neckar, the new chief engineer has been acting as deputy minister of the department since Mr. Michaud was granted leave of absence on account of ill health, and is well known in Montreal engineering circles.

Mr. H. Jardine, a native of Hespeler, Ont., was recently appointed assistant to City Engineer D. T. Black, at Galt, Ont., filling the vacancy caused by the resignation of Mr. Roy Paterson. The new appointee is an honor graduate of Queen's University and received the military cross for service overseas. He was for a time assistant engineer in the town of Timmins, Ont.

The firm of Ewing, Lovelace & Tremblay, civil engineers and land surveyors of Montreal, have dissolved partnership, Messrs. Lovelace and Tremblay having formed a new partnership under the name of Lovelace & Tremblay, and Messrs. Ewing and Tremblay having entered into a separate partnership, under the firm name of Ewing & Tremblay. The headquarters of the two new firms will be at 14 Phillips Square, Montreal.

Mr. Joseph L. Boulanger, formerly private secretary to the Quebec Minister of Roads, Hon. J. L. Perron, has been appointed Deputy Minister of Roads, in the recent re-organization of the Department. Mr. Boulanger succeeds Mr. Ben. Michaud, who was given six months leave of absence last winter, following a break in his health. Mr. Michaud was the first deputy minister of the department, serving under Hon. J. A. Tessier who became head of the department when it was created in 1914, and following Mr. Tessier's retirement served as deputy minister under Mr. Perron.

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Getting the Confidence of County Councils

Rarely does a county road superintendent prepare such a comprehensive and complete report of his activities as has E. L. Miles, M.E.I.C., road superintendent of the county of Victoria, Ont. So favorably has his report for the year 1921 appealed to us that we consider it worth while to comment on it and commend it to other road officials who are content with reporting their work in only a brief formal statement. Mr. Miles' report is a 36-page printed pamphlet containing very detailed information regarding the roads of the Victoria County highway system. Its author has taken particular pains to present accurate cost data on each road referred to, appending the necessary information to justify these costs. Introductory to the main report, there is a general treatise on the necessity for improved highways and the economic considerations relating to their construction.

Mr. Miles apparently realizes that he is dealing with a body of men in the municipal council who are anxious to get the worth of the money they spend and he seeks to convince them that he has done his duty in this connection. He therefore takes the members of the council into his confidence and by convincing them of the importance of improved highways and giving them the fullest details regarding his work, justifies his activities in their sight.

This is a practice that all too few county road engineers and superintendents are able to carry out. We know counties in which there is constant differences of opinion between the engineers and the county councils. Instead of these differences, there should be the closest co-operation, so that there may be developed the best possible system of highways, consistent with the money that the council has to spend. In the final analysis, the council, as the representative of the people, is the body that has to be satisfied as it provides the money. At the same time, no sound principal of engineering practice should be sacrificed in the matter of the design, construction or maintenance of the highways. In order to get the greatest value, therefore, for the available money, it is necessary that there be the closest cooperation between the engineers and the council and the greatest confidence of one in the other. The report of Mr. Miles seems to indicate that this ideal has been realized in Victoria county.

The High Cost of Fires

The fire loss in Canada during 1921 amounted to more than $45,000,000 and exceeded that of any previous year in the history of the country. Returns for the present year indicate that conditions are going from bad to worse. Although no conflagration of note has occurred, the widespread burning of property continues on an unprecedented scale. During the first four months of 1922, losses have amounted to $19,206,000, or almost $5,000,000 per month. The unpleasant fact must be faced that in all probability fires will continue to increase until there is a marked recovery from general business depression. The decline in values of many basic commodities is practically completed, but there still lies ahead the inevitable collapse of urban real estate values and a substantial reduction in the costs of production, transportation and distribution. Such deflation, whether gradual or sudden, will affect the values of all insurable property and will undoubtedly be reflected in the fire loss record.

At the present time, all public bodies are making determined efforts to effect economy in expenditure. The burden of taxation has become too grevious to be borne indefinitely. Strange to say, however, no great objection is manifested towards the unnecessary burden imposed upon the country at large by our wanton destruction of property by fire. Taking for instance, the waste in 1921, a general estimate would appear as follows:—

Vaule of property destroyed	$45,015,930
Insurance Premiums in excess of Losses Paid	24,544,200
Waterworks (cost chargeable to fire service)	8,756,340
Fire Departments in Protected Communities	12,137,500
Private Fire Protection (estimated)	7,958,000
Fire Prevention (Government expenditure)	13,500
Total	$98,435,470

This tremendous sum of almost $100.000.000 is paid directly by property owners, but subsequently, through the channels of commerce, every individual in Canada must bear his or her share of the burden. So distributed it amounts to $11.25 per capita of the population and constitutes a tax of more than $50 per annum upon the average family. It is questionable whether there is any other national diversion for which the people of Canada spend so much and receive so little.—From "Fire Control."

Car Houses for the Toronto Transportation Commission

Large Additions to the Danforth Ave. and St. Clair Ave. Car Sheds —Reinforced Concrete Construction—Details of the Design and Layout

To provide adequate facilities for the housing, inspection and repair of its rolling stock, the Toronto Transportation Commission has, since it took over the street railway system of the city, been enlarging the St. Clair Avenue and Danforth Avenue car houses. These sheds, which are now practically completed, are two of the largest storage areas operated by the Commission and are far and away the most modern in design and construction. Both car houses are extensions of accommodation that had been provided several years ago in connection with the Toronto Civic Railway. However, in the additions, better facilities have been provided for the inspection and repair of cars and a superior type of construction, involving all concrete, has been adopted. The yard areas for storage of cars have also been considerably extended in each case. In addition, new office and car crew facilities have been added.

Danforth Car House

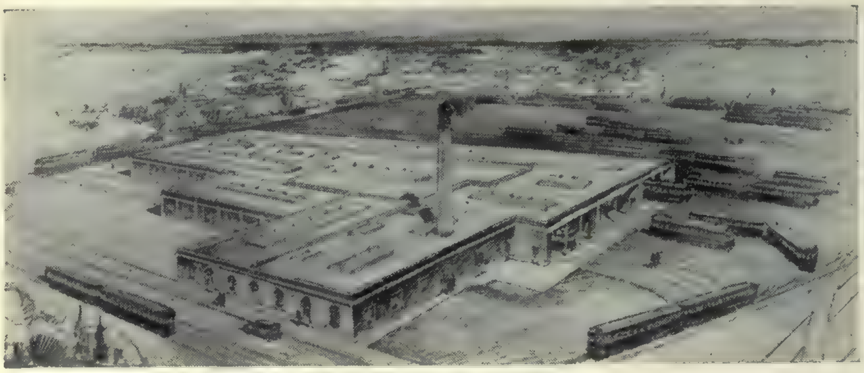
The original Danforth Avenue car house comprised an office and stores building, measuring 110 ft. by 50 ft. and two sheds, 110 ft. by 44 ft. and 215 ft. by 44 ft. respectively, each containing three tracks and the two providing accommodation for 12 cars. The recent additions involve an extension of the office building to a width of 70 ft., enlargement of the existing car houses to a total length of 344 ft. each, the erection of an entirely new car house 344 ft. long by 44 ft. 6 in. wide, and the construction of a repair bay 146 ft. long by 44 ft. 6 in. wide. The accompanying plan shows the relative location of these units. The area under cover is 61,900 sq. ft., which, with the enlarged yard area, will provide accommodation for 230 cars. The length of tracks involved in the project is 12,400 ft., including 80 switches.

The original car houses were of exposed steel frame construction with brick and tile curtain walls and wooden roof, and while they were used as a nucleus for the larger scheme, it was decided to adopt reinforced concrete for the additions in view of the greatly reduced fire hazard and the consequently smaller insurance premium obtainable. The design involves concrete columns resting on continuous inverted girder footings, the roof being carried on concrete girders of 44 ft. 6 in. span. The roof is of the concrete beam and slab type. The walls are of brick and tile curtain design, the outside walls being brick faced, while interior walls are painted. In each inspection bay are incorporated three tracks, carried on steel columns resting on concrete pedestals. The inspection and repair pits extend the full length and width of the car houses and are 4 ft. 9 in. deep. They are lighted and heated and are of fireproof construction.

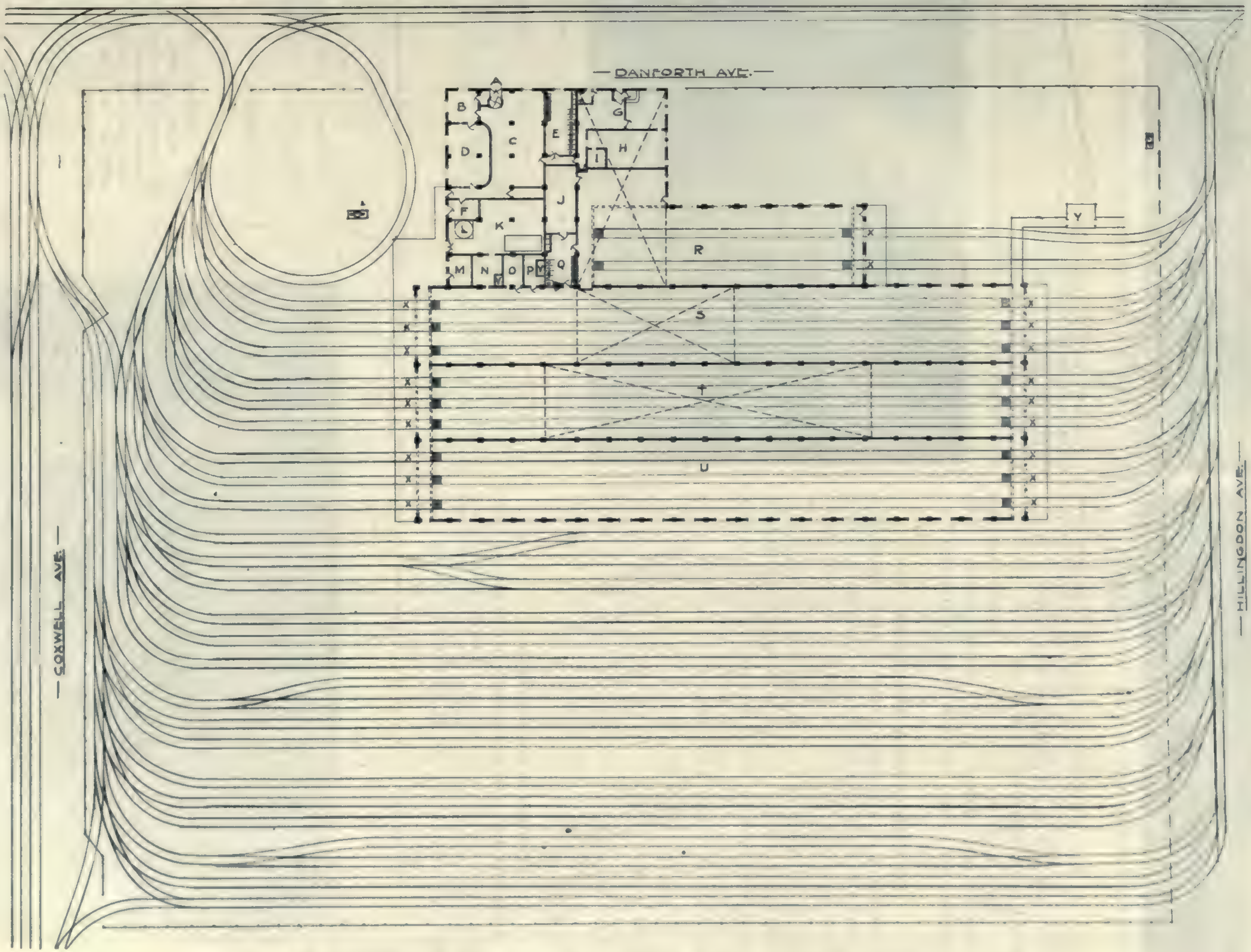
The office and stores wing of the Danforth Ave. car houses

The ends of each bay are closed by rolling steel doors, electrically operated. The importance of natural light has been kept prominently in mind and ample skylight area has consequently been provided. A sprinkler system adds to the safety of the structure and helps to reduce the insurance premium.

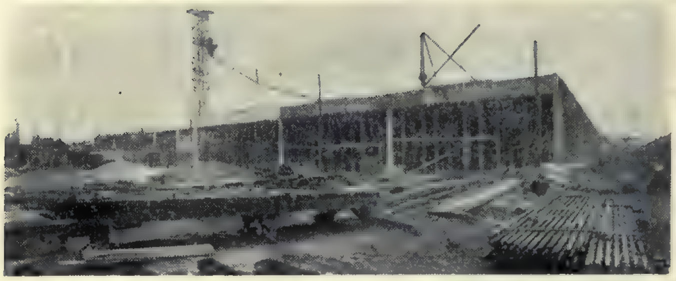
The heating of the inspection bays is by a hot air system, the air for heating being circulated by two fans through the vento heaters, then along a main



Perspective of the Danforth Ave. car houses.



Layout of the Danforth Ave., car houses and yards of the Toronto Transportation Commission



A construction view of the Danforth Ave. car houses

A portion of the Danforth Ave. car sheds and yards

concrete duct running under the pits. From this duct secondary tile pipes convey the air under the pits for the full length of the building. The office sections are heated by direct steam radiation.

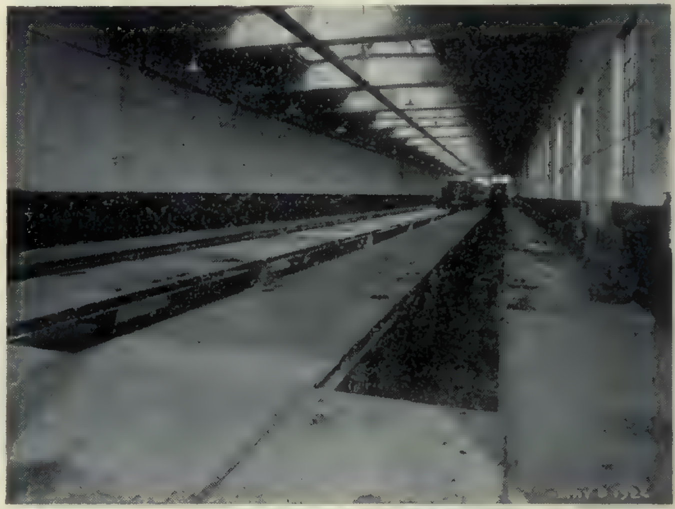
The office quarters have every facility for the convenience and comfort of the train crews. Five hundred and forty men operate in the Danforth division.

St. Clair Avenue Car House

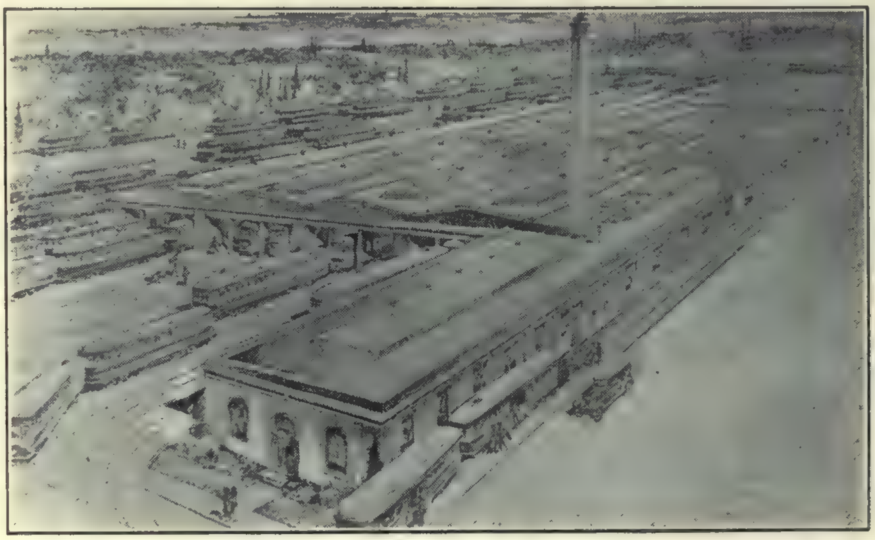
In general design the St. Clair Avenue car houses are similar to those just described. Originally, there were two buildings 200 ft. by 44 ft. each, with three tracks and having a total housing capacity of 18 cars. These building were of exposed steel frame construction with wooden roof. As in the Danforth car houses, reinforced concrete is used for the new additions, which involves two inspection bays, 230 ft. by 44 ft. 6 in. and a repair bay and office sections, 326 ft. by 44 ft. 6 in. Each inspection bay contains three tracks. The same type of heating and lighting has been used. The total area of the site is 4½ acres, 47,800 sq. ft. being under cover. Accommodation for 162 cars is provided. The length of tracks is 9,500 ft. with 45 switches. About 480 men are attached to the St. Clair Avenue division.

Construction Methods

Nothing unusual was demanded in the way of construction methods. Excavation was carried out in each case by steam shovel, while concrete was poured from buggies or chutes, being lifted to the roof level on a hoist tower. Owing to the unusual length of the roof girders, special care had to be taken with the shoring. Wells & Gray, Ltd., Toronto, were the general contractors on the Danforth Avenue car house and Jackson-Lewis Co. Ltd., Toronto, were the contractors on the St. Clair Avenue shed. The work was supervised by the Building Department of the Toronto Transportation Commission, under the direction of Mr. W. E. P. Duncan, with Mr. J. B. Carswell acting as consultant.



The interior of one of the inspection bays showing the reinforced concrete construction and the repair pits



A perspective of the street car shed extensions which the Toronto Transportation Commission has built on St. Clair Ave., Toronto.

What is the Best Time to Surface Concrete with Asphalt?

An Economic Study of the Factors Involved in the Construction of Concrete Highways With and Without an Asphalt Surface—Determination of the Relative Expense

By **W. E. ROSENGARTEN**
Traffic Engineer, the Asphalt Association

Before State Conference of Mayors and City Officials, Poughkeepsie, N.Y.

Because of the keen competition among the various types of pavement we are apt to lose sight of their inter-relationship and to regard them as distinct and independent types. A moment's reflection makes clear the fallacy of such an impression. Brick pavements are now laid with asphalt filler and there are developments along lines of asphaltic base and cushion so that this type of pavement is now about as distinctly an asphalt pavement as are asphalt macadam, asphaltic concrete and sheet asphalt. The same holds true in the case of granite block. Portland cement concrete, it is true, starts with only the bituminous joints but it uses a bituminous filler for cracks and there are few engineers who oppose the soundness of the practice of ultimately surfacing the concrete with an asphalt top. As a matter of fact few engineers disagree with the practice of resurfacing any type of pavement constituting a stable foundation with a wearing surface of asphalt. There is really then no actual antagonism between asphalt and the other types of pavement, This I wish to make clear so that what I have to say here may stand as an economic presentation free from commercial bias.

Another point to which I wish to call attention is that, so far as the relationship of asphalt to other materials is concerned, it is generally speaking helpful to the use of other materials rather than supplanting them. For example, in a 3 inch asphalt pavement with a 6 inch 1:3:6 portland cement concrete base there are but 24 lbs. of asphalt as against 69 lbs. of portland cement, 19 lbs. of lime stone dust, 362 lbs. of sand and 557 lbs. of stone. The following table shows the approximate weight of materials used in one spuare yard of various types: —

Materials Used in One Square Yard of Pavement

Type	Asphalt	P. Cement	Filler	Sand	Stone	Misc.	Total
3" sheet ashpalt, 6" 1:3:6 P.C.C. base	23.8	69.	18.9	362.4	556.6		1030.
3" brick asph, filler, ¾" 1:3 cement sand cushion, 6" 1:3:6 P.C.C. base	17.	89.	—	255.	463.	300 brick	1124.
8" 1:1½:3 P.C. con- tom course stone, joints	0.3	170.	—	241.	572.	8 reinf.	991.
2½". bit. mac. top 1¾ gal., 3" bottom coarse stone, 8" fn'dn. stone	16.	—	—	--	1062.		1078.

Regarding asphalt therefore as an important factor in each type of pavement rather than as a type distinct and apart it is pertinent to study the economics of its relationship to other materials and types without giving any great weight to the question of competition.

Asphalt Surfaces on Concrete Bases

Just now in view of the more general use of the plain and reinforced portland cement concrete and the asphalt surfaced highways on country roads much prominence is being given to the question as to whether it is more economical to construct a portland cement concrete pavement and delay placing the asphalt surface until deterioration of the pavement renders it necessary or to construct the complete pavement of concrete base and asphalt top at the outset. Maryland has followed the former course and has obtained an average of from 5 to 7 years use of the concrete before placing an asphalt top on the old pavement.

Laying aside for the moment all considerations save that of ultimate cost over a period of years, say 40, it cannot fail to be helpful to weigh the economic results of the two methods. Certain factors must enter into such a consideration. These are (a) first cost of the concrete base, the asphalt top and of the complete portland cement concrete pavement; (b) interest rate; (c) life in years of the base, the top and of the concrete pavement before resurfacing.

In any specific case we have the actual first cost values; thus the assumptions open to controversy are those of the life of the respective portions of the pavement under (c). Even there we have much reliable evidence as to the average age of asphalt pavements. The 1921 report of the Engineer Department of the District of Columbia, says in connection with its asphalt pavements "that some of the streets approximate an age of 40 years and that the average age of those we have resurfaced in recent past years exceed 25 years." The Department of Public Works of Manhattan Borough, New York City, has advised us that they find the average age of their asphalt pavements at time of resurfacing to be 18.2 years including the most heavily traveled streets open to truck traffic. The annual report of the Bureau of Engineering of the city of Buffalo for 1919 gives the average age of asphalt pavements replaced in the four years previous as 24.47 years. We have been advised by the chairman of the Paving Commission of Baltimore that the average age of asphalt pavements in that city is in excess of 25 years.

Life of Concrete

In this paper I have however, assumed a life of only 20 years for the asphalt top, preferring to lean to the side of conservatism. For the concrete base, whether it be laid at the outset as a base or used as a wearing surface and later as a base, I have estimated 40 years. This may be too liberal in view of the possible unsuitability of the concrete pavement as a base after deterioration. This leaves for determination the period of time which may be allowed for the concrete pavement laid as such before an asphalt top becomes necessary in order to prevent economic loss. As I have already stated, Maryland has found this period to lie within about 7 years. California has found it to be even less. True these states have laid pavements of leaner mix and lesser thickness than other states but if we seek to glean facts from service history we must turn to those pavements which have been down long enough to yield such facts. According to the best available figures I find that 95% of all the portland cement concrete roads in this country today are less than 7 years of age and their average age probably not more than 3 years. Let us assume that within reasonable cost limits the concrete pavement will go 7½ years average before an asphalt top is required.

Let us now see from an actual cost analysis how this works out. As a basis for comparison it may be considered that the original outlay for any part of the construction will be paid off by equal annual amounts extending over the life of the improvement. This annual cost can be found readily by consulting standard annuity tables or curves as given in Figure 1. for the appropriate rate of interest and the life of that portion of the pavement under consideration. By this annuity method we have a very simple means of determining the relative annual and also the total costs for various types of construction. Let us take as a specific case, a concrete road 7 inches thick, 1:2:4 mix, which costs $2.50 per square yard. After 7½ years it is surfaced with two inches of asphaliic concrete costing $1.30 per square yard. Compare this with 5 inches of portland cement concrete base, 1:3:6 mix, surfaced at the outset with two inches of asphaltic concrete at a total cost of $2.80 per square yard. The life of the portland cement concrete regarded as a base is placed at 40 years and the asphalt wearing surface at 20 years.

Comparative Costs

The annual cost as well as the total cost of the various portions of the pavements included in this discussion are obtained from the annuity tables in Fig. 1. in the following manner. Take, for example, the portland cement concrete pavement costing $2.50 per square yard used first as a pavement and later as a base for a combined period of 40 years and if we assume an interest rate of 5% on the investment, we find from the annuity curves or the annuity table that an expenditure of $1.00 can be paid off over a 40 year period by annual payments of $.0583. An expenditure of $2.50 would therefore, require annual payments of 2.5 times $.0583 or $.1457. This would make a total in 40 years of $5.8278 per square yard. Similar costs for the other portions of the pavements are as follows:—

Type	First cost	Interest rate	Life years	Annual cost per sq. yard	Total cost per sq. yard.	
					Years	Amount
Portland cement con. pavement (used as a base after 7½ years)	$2.50	5%	40	$0.1457	40	$5.8278
Asphaltic surface	1.30	5%	20	.1043	32½ 40	3.3897 4.1720
Portland cement concrete base	1.50	5%	40	.0874	40	3.4967

Taking a period of 40 years for comparing these two methods of construction, since this is the estimated life of the base, we find the total cost of the portland cement concrete pavement surfaced after 7½ years with asphalt, to be $5.8278 plus $0.1043 times 32½ years or $9.2175 while on the other hand the total cost of portland cement concrete base surfaced originally with asphalt is $3.4967 plus $0.1043 times 40 years or $7.6687.

From this we see that there is a saving by constructing the road originally with an asphalt surface on a concrete base of $1.5488 per square yard. Thus the cost is 20.2% greater when the placing of an asphalt surface is delayed than when it is made part of the initial construction.

I would call your attention to the interesting annual cost comparison shown graphically in Figure 2. It will be noted that there is a saving in favor of the concrete pavement during the first 7½ years but after that a considerable cost differential is shown in favor of the pavement which is surfaced with asphalt at the outset. Figure 3 shows graphically an analysis of total costs. Here we note that the portland cement concrete pavement surfaced after 7½ years with asphalt shows a less total cost up to the 13th year and from then on the economy of the pavement originally surfaced with asphalt is apparent.

It will be noticed that the slope of the lines in the charts is determined by the annual payments. Thus the slope for the portlant cement concrete pavement changes to a steeper angle when the asphalt top is laid due to the increase in annual cost necessary to cover this addition. With this in mind we can obtain readily some very interesting information from the diagram. You are not required to accept my estimate of 7½ years as the time for surfacing the portlant cement concrete pavement. Put your own estimate into the problem and see where the curve takes you. If you say the period should be 10 years the comparison is shown by drawing a line with the same slope as the upper line in the diagram year point. This you will find will reduce the total cost but slightly. If you put the time for placing the asphalt surface at 12 years the total cost will still be well above the total cost of the pavement originally surfaced with asphalt. In fact as you see by following the curves out, the unsurfaced concrete must go 22½ years to make it as economical as the method of laying base and top at the outset.

Effect of Variation in the Factors

Now to give you the benefit of variation in the

Years	4%	5%	6%
1	1.0400000	1.0500000	1.0600000
2	0.5301961	0.5378049	0.5454369
3	0.3603485	0.3672086	0.3741098
4	0.2754901	0.2820118	0.2885915
5	0.2246271	0.2309748	0.2373964
6	0.1907619	0.1970175	0.2033626
7	0.1666096	0.1728198	0.1791350
8	0.1485278	0.1547218	0.1610359
9	0.1344930	0.1406901	0.1470222
10	0.1232909	0.1295046	0.1358680
12	0.1065522	0.1128254	0.1192770
15	0.0899411	0.0963423	0.1029628
20	0.0735818	0.0802426	0.0871846
25	0.0640120	0.0709525	0.0782267
30	0.0578301	0.0650514	0.0726489
35	0.0535773	0.0610717	0.0689739
40	0.0505235	0.0582782	0.0664615

Fig. 1—Annual cost required to retire a dollar investment with interest at various rates

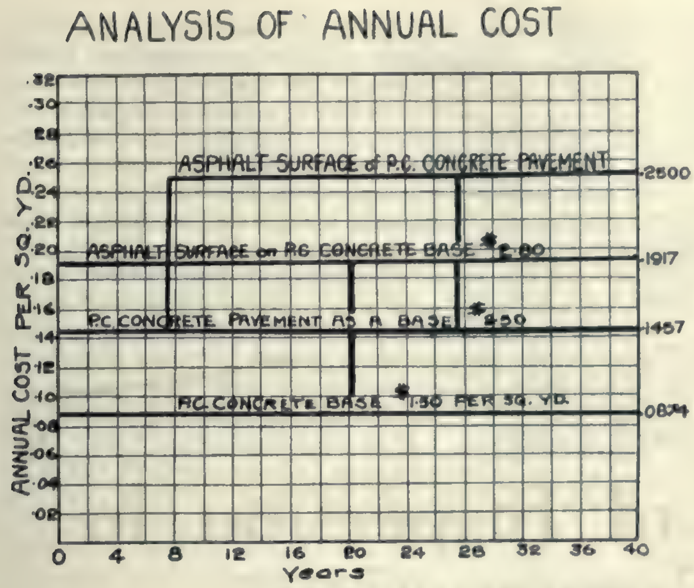


Fig. 2

factors let us first show a variation in design. The first charts show a 7 inch 1:2:4 portland cement concrete pavement costing $2.50 per square yard resurfaced after 7½ years with a 2-inch asphaltic course costing $1.30 per square yard compared with a 5 inch 1:3:6 concrete base surfaced with 2 inches of asphalt costing $2.80 per square yard.

Figure 4 calls for an 8 inch 1:1½:3 portland cement concrete pavement costing $3.00 per square yard surfaced after 10 years with 3 inches of sheet asphalt costing $1.50 per square yard compared with a 6 inch 1:3:6: concrete base surfaced with 3 inches of sheet asphalt costing $3.00 per square yard. The annual and total costs under these conditions are as follows:

Type	First cost	Interest rate	Life years	Annual cost per sq. yard	Total cost per sq. yard	
					Years	Amount
8″ 1:1½:3 P.C.C. pavement	$3.00	5%	40	.1748	40	6.992
6″ 1:3:6 P.C.C. base	1.50	5%	40	.0874	40	3.496
3″ sheet asphalt surface	1.50	5%	20	.1204	(30 (40	3.612 4.816

Thus we have for the total costs, portland cement concrete pavement, $6.992, plus an asphalt surface for 30 years costing $3.612 or a total of $10.604, as compared with the portland cement concrete base, $3.496, plus an asphalt surface for 40 years, $4.816 or $8.312 differential of $2.292 or 27½% in favor of the pavement surfaced with asphalt at the outset.

Varying the Costs

Next let us see what a variation in costs will yield. Turning back to the first problem and assuming as before the life of the portland cement concrete as a base to be 40 years, the life of the asphalt surface as 20 years and the time for surfacing the portland cement concrete pavement as 7½ years, we have by reference to the annuity table the following relation:

Let C=first cost per sq. yd. of port. cem. conc. pavement
K=first cost per sq. yd. of port. cem. conc. base
A=first cost per sq. yd. of the asphalt surface
P=annual payment for a first cost of $1.00 obtained from the annuity table for the appropriate period p.

The total cost of the P. C. C. pavement surface after 10 years is P40x10xC+P20x32½xA=2.332C+2.607A . . . . (1)

The total cost of the P. C. C. base with asphalt surface is P40x40xK+P20x40xA=2.332K+3.208A . . . . (2)

Let us make a variation of 20 cents each way from the first costs assumed of $1.50 for the concrete base and $1.30 for the asphalt surface. Substituting in the above formula we have when:

C=$2.50; K=$1.70; A=$1.10,
(1)=2.332 x $2.50+2.607x1.10=$8.698
(2)=2.332 x $1.70+3.208x1.10=$7.493

showing a total increase of $1.205
or 16% when the asphalt surface is delayed.

When C=$2.50; K=$1.30; A= 1.50
(1)=2.332x$2.50+2.607 x $1.50=$9.740
(2)=2.332x 1.30+3.208 x 1.50= 7.843

showing a total increase of $1.897
or 24% when the asphalt surface is delayed.

This relationship is shown graphically in Fig. 5.

To view this from still another angle let us find how much we are justified in paying for the portland cement concrete pavement over and above the cost of a portland cement concrete base if the pavement will give service unprotected for 7½ years. The difference in total cost in the first problem was $1.5488. This represents an initial payment 40 years previously of $0.665 obtained by dividing the $1.5488 by 2.3311. The last figure is arrived at by taking the appropriate figure in the annuity table which is then multiplied by 40 to get the aggregate cost of a $1.00 investment over a 40 year period. This indicates that the initial cost of the portland cement concrete pavement of $2.50 must be reduced by $.66 giving

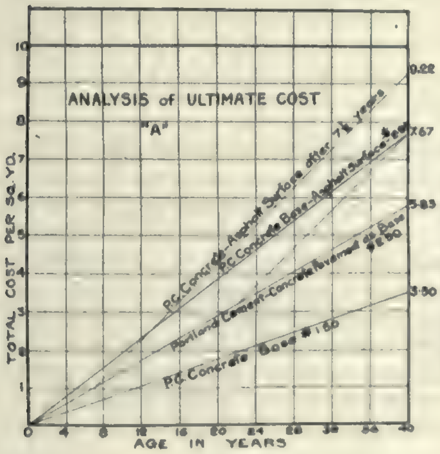


Fig. 3

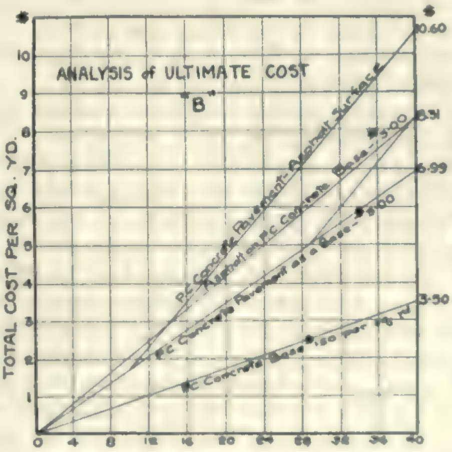


Fig. 4

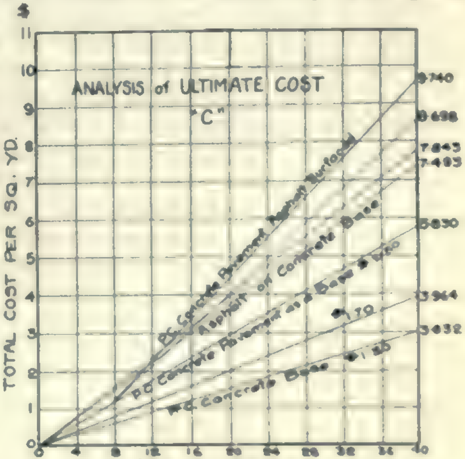


Fig. 5

$1.84. We therefore, find that we can pay but 34 cents per square yard more for a first class portland cement concrete pavement than for a portland cement concrete base to be used under an asphalt surface, or a difference of no more than one third than now prevailing in actual construction practice.

No Material Difference in Maintenance

Let me again emphasize my opening statement that the whole purpose of this paper is to analyze cost of the two methods from a strictly economic standpoint. There are many factors such as ease of traction, appearance noiselessness, etc., which the engineer will consider other than that of cost and each in itself would serve as a subject for a paper but I feel that in the interest of clear thinking and sound practice this one very important consideration should be studied exhaustively on its own merits. One factor which might seem to have a place in this discussion is that of maintenance but it is not material to the discussion I can easily show you. As the portland cement concrete in the examples cited is covered with asphalt 32½ years of the 40 years, or in any event over the major portion of the period, the difference in maintenance cost would be only for the portion during which the concrete was serving as a pavement and this difference would be spread over the entire 40 years. You can see, therefore, that the difference in maintenance costs between the two methods would be at most no more than a fraction of a cent per yard either way and would not materially affect the totals.

The Importance of Inspection in Highway Construction

How Pennsylvania Handles its Inspecting Staff---Inspection Begins Prior to the Making of Surveys---The Award of Contracts is Made a Matter of Thorough Study

By H. E. HILTS
Principal Assistant Engineer, Pennsylvania Highway Department

Before the American Society of Civil Engineers

It has been found in the Pennsylvania State Highways Department that, in connection with the construction of a large mileage of durable highways, the work of the executive is that of an adjudicator and that the work at headquarters is simplified and systematized by the careful manner in which inspection work is handled on the construction contract. Mr. MacDonald has expressed the thought that inspection is not just inspection on contract work, and the speaker believes that all will agree that his views are conservative, but, nevertheless, the inspector can many times reach decisions that will lessen the work of both the district office and the main office of a department. The design of highways is subject to standardization and work of this character can be systematized. Plans can be carefully checked, but inspection depends on the man assigned to it; therefore, all inspectors should be selected with care.

Selection of Construction Inspectors

The work of a survey corps can be systematized and checked, but after the work of an inspector has been done, checks may be made, but errors are costly to correct. In Pennsylvania, candidates for inspection work are not selected by civil service, the policy of "hiring and firing" being preferred. It is believed that all inspectors should be interviewed at headquarters before being employed. The candidate, on being employed, is told that he should consider himself a servant of the public, and that as far as emoluments of office are concerned, he must realize that the satisfaction of building a road that is a credit to the department and to the commonwealth, must serve, in his own mind, as additional recompense. He is told that as far as the department is concerned, he is not merely building route number so and so, but in the future the contract on which he is employed will be known as the road that Inspector "Smith" supervised. In other words, an attempt is made to appeal to the human element and arouse the candidate's ambition so that he will deliver a real job.

Inspection Preliminary to Surveys

The inspection of construction is only a small part of inspection work. Preliminary to the making of surveys for the preparation of plans, the district engineers inspect existing roads, which they know will be improved in after years. In other words, every trip a district engineer makes over an unimproved road permits him to visualize re-locations or changes in roads, and in the spring of the year these trips are particularly valuable in the inspection of drainage conditions.

All construction plans are premised on careful studies of drainage, and an endeavor is made to locate both sub-surface and surface drainage structures so that they will answer not only the ordinary conditions, but also extraordinary conditions as developed during the heavy winter of 1919, when roads that had been constructed for years, gave signs of distress during the spring thaw. These inspection trips, as they respect drainage, should be summarized by adequate notes which can be interpreted by the men in the office, who are designing the road.

Inspection During Preparation of Plans

After a survey has been made on the line established by the district engineer, a preliminary inspection with the blue prints of the project at hand, is made by the district engineer and a representative from headquarters, and if the project is a particularly difficult one, this preliminary inspection is made on foot. At this time, it is decided whether the alignment chosen is the best, and in checking this feature, it has been the endeavor to teach the men that the laying out of the highway, from the viewpoint of economy, must be developed by a study of distance, of maximum and ruling grades that will set traffic conditions, the elimination of unnecessary rise and fall, and of dangerous curvature. This does not mean that in highway work, the refinement used by the railroad engineer has been reached, because in many cases one cannot visualize or even approximately determine which of the previously mentioned features of construction is the most important, whether it is elimination of rise or fall, or curvature, maximum or ruling grades, or a study toward the elimination of distance. The traffic has changed so rapidly in the last 10 years that it would appear that even the present-day engineer would have to be the seventh son of a prophet in order to anticipate traffic conditions ten years hence. The checking of judgment by figures in establishing maximum grades, rise and fall, and curvature, which really amounts to the setting of business limits for economical expenditure of funds at this time, must be premised on anticipated traffic which the road will have to bear 5, 10, or 20 years hence.

Another type of inspection is that of determining the kind of surfacing material which is to be used, and it is felt that, in deciding this question, an inspection on the ground by the district office is most important, so that full data may be secured as to the availability of materials, the nature of the termini of the road, and the present and the anticipated traffic which the road will take.

It has been found that the selection of type should not be based on the first cost alone, but should represent an investment, particularly where bond-issue moneys are concerned, which will, in some measure, be available after the bonds have matured, this investment not only being made up of grading and drainage structures, but also of the surfacing material. The competition between types, where such competition is based on engineering judgment, is healthy and stimulates or results in lower prices, induced by more efficient business methods in the construction of the road.

Inspection to Determine Availability of Local Materials

The preliminary inspection as carried on by the district engineer is made almost simultaneously with an inspection made by the engineer of tests or his representatives, who examine the availability of local construction materials, the matter of inspection many times requiring from 3 to 5 days on a 3 or 4-mile project. The representatives of the engineer of tests blast out ledges and dig test pits, so that representative specimens may be obtained, and the quantity of materials available may be determined. This work has proven to be of extreme importance. In 1919 there were only about 8 per cent of the contracts on which local material was used. In 1920, some local material was used on 28 per cent of the contracts, and, in 1921, there has been an increase in the use of suitable local materials, which has necessarily resulted in a lowering of the first cost of the road.

The mechanical testing of materials, in a well ordered department, is mostly by systematized routine, and the writer feels justified in stating that the most important feature of tests is their interpretation. Experience in his work is a fundamental requirement. The writer might illustrate by a comparison of the different kinds of stone in Pennsylvania, which vary from coarse grained sandstones to heavy dense trap rock. There is no sand in many parts of the state, and it has been necessary to prepare sand artificially by grinding coarse and fine grained sandstones. Studies were made, which pointed to justification in using artificial sands and in using good sands in combination with relatively poor aggregates, these results having been reached only after the construction of a test road in which various types of materials were used in combination. Test specimens were studied during the construction of the road and compared with specimens taken from the road after it had been in service for a period of six months.

The writer has dealt with inspections made preliminary to surveys and during the preparation of plans. All these inspections have one objective, that is, to have the plans as nearly perfect as possible, and to submit them to the contractor so that he may have full information regarding the roadway under consideration. Each contractor is given, on his proposal form, the estimated quantities as nearly as they can be determined and on a supplementary sheet he is furnished with the local materials which might be used in the construction work, and their location, with the provision, however, that no guaranty is given as to the continuation of quantity or quality of materials as sampled. It is found that the engineers of the department have used judgment in the preparation of all this material, but it is also suggested and recommended that the contractor, before basing his bids on local materials, should analyze the location on the ground and examine the test pits and the ledges.

The final field inspection also furnishes information on which to base the time limit on the contract. A 5-mile contract has been built by an efficient contracting organization, in as short a time as 70 days; another contractor not as efficient might have required 3 years in building the same project. It is endeavored, as far as possible by inspection in the field, to work out a conservative time limit for every contract.

Inspection of Business of Awarding Contracts

Only the engineering phase of contract work has been considered in all the inspection details mentioned. Another phase, however, is the inspection of the business of awarding contracts. This has been accomplished in Pennsylvania by calling to Harrisburg for interview each contractor who has been a low bidder. At this interview the assistant commissioner of the department discusses with him the matter of equipment which he contemplates using on the work, this discussion being premised on a list of the major items of equipment which has been carefully prepared by the engineers of the department. This list is prepared on the basis of the minimum amount that should be used in completing the work within the contract time, and it is thoroughly understood, by a gentlemen's agreement, that the equipment finally decided on at the conference will be used on the work. Furthermore, the contractor advises whether he owns the equipment, is going to buy new equipment, or is going to rent it. Careful attention is given, in the discussion, to the method of handling the work and as to the contractor's qualifications, based on previous experience in handling men, and as far as the labor situation is concerned, local or imported labor is discussed, and the establishment of commissaries is considered.

It has been difficult at times, during the past three years, to have materials delivered in sufficient quantities and with sufficient regularity to handle the construction work economically. Therefore, the assistant commissioner requires the contractors, during the discussion, to outline a fairly definite program, as to where they expect to purchase materials, so that the department in turn from its previous experience can determine whether materials will be forthcoming, so that the contractor will experience minumum delays. It has been found that this procedure is warranted, inasmuch as it may result in speeding up the work and in reducing the hazard of having to complete one season's contract during the following season, thus causing serious financial loss to the contractor as well as to the state, inasmuch as the new road will not be completed over the winter and spring months.

The Question of Finances

In order that contract work may be handled promptly and efficiently, every contractor must have financial resources and, in the interview with the assistant commissioner, he must furnish evidence that he is financially able to handle the work, not from a surety point of view, but rather from the point of view of ready cash or stocks or bonds that he can use to raise money, or lastly, from the presentation of letters from banking concerns which express confidence in his ability and their willingness to finance him in an amount equal to at least 20 per cent. of the cost of the work. Following the usual practice, the contractor also furnishes a surety bond from an approved surety company in the amount of 50 per cent. of the contract cost. The interview with the assistant commissioner is not at all one-sided, inasmuch as he endeavors to impress on the contractors the thought that 100 per cent. work is being looked for and that plans and specifications are prepared to be followed, and, further, that, in order to obtain a 100 per cent. job, the department and the contractor must give each other 100 per cent. co-operation.

The inspection of materials is made at the source of supply, in order to protect the materialman and the contractor, but this inspection is only preliminary. Inspection is also made at the delivery point of the contract, but this can be considered only as preliminary, the final inspection of materials being as they go into the work. It is endeavored to foster high ideals in the minds of the men by proper instructions in readable, illustrated form. The men have been instructed at headquarters and at district office schools, and three of the universities of Pennsylvania have established short courses in which particular emphasis have been given to the tenets of contract law and specifications.

Cost of Surveys, Plans and Inspection

Questions often have been raised as to the cost of making surveys, preparing plans, and inspecting contract work, and there is a lack of data in engineering literature on costs of this nature. Take about 25 contracts, which were available and on which tabulated costs have been completed; these jobs include those which have been finished rapidly and on which the plans were prepared quickly, as well as those which were studied for two or three years, and on which the contractor made slow progress, due to weather conditions, the non-delivery of materials, etc. It is found that the cost of these 25 contracts has averaged $524.00 per mile, for field and construction surveys; $175.00 per mile for the preparation of plans; and $891.00 per mile for inspection work; the total cost expressed in percentage of the contract price being 2.96. The cost of inspection and tests of materials has averaged about one-fourth of 1 per cent. of the contract price of the road. In other words, the engineering costs have averaged less than 3¼ per cent. of the contract price, and the speaker submits that this is cheap insurance to the taxpayers of the commonwealth, and at the same time, furnishes the department definite assurance that it has done its part in working out an efficient and economical method of handling contract work.

Experiences with Light Cast-Iron Pipe

By C. E. INMAN

Before the American Water Works Association

Thirty-eight years' experience under water-works contractors who employed able engineers and further experience as superientendent of water-works in a number of widely separated cities, during which I have seen laid much cast-iron pipe lighter than is demanded by the standard specifications in use for some years past, combined with the satisfactory experiences given by that pipe and by much other light pipe of which I have learned by correspondence or otherwise, leads me to advocate the more general use of the lighter weights than are now current. In each town and city observed, the pipe was tested under 150 lbs. pressure after it was laid. In one city, the pressure is run up daily, at noon, to 120-lb. pressure. In this and a number of other cities there has occurred, so far as my information goes only one failure of the light weight pipe.

As far back as 1887, the late George A. Ellis, published a statement in which he gave the general verdict of engineers, after long discussion and experiment, against using 40-lb.-per ft. 6-in. pipe when 28-lb. pipe will serve the purpose with equal safety.

If Classes A, B, C and D pipe, of less than 20-in. diameter, all poured from the same mix and melt, are foundry tested under 300-lb. pressure, why advise A for 43 lb., B for 86 lb., C for 130 lb. and D for 173 lb. per square inch?

Discussion: J. N. Chester, Pittsburg, Pa., said that when, many years ago, he became connected with the American Water Works & Guarantee Co., it was laying 100 miles of pipe yearly, of which 80 per cent was 6-in. weighing only 30-lb. per foot. He became a convert to that practice. Those who fixed the standard higher, although well intentioned, have loaded the country with many tons of unnecessary pipe weight. William F. Wilcox, Ensley, Alta., said that for many years past 30-lb. weights have been used for 6-in pipe in the south. Leonard Metcalf, Boston, Mass., remarked that much light-weight has been used in New England.

Many engineers are convinced that the best type of under-drain for highways is vitrified clay pipe with bell and spigot joint, when bedded in two or 3 inches of clean broken stone or screened gravel and the pipes covered with the same material. They claim that sewer pipes are harded burnt than the ordinary land tile and are better fitted to stand the shocks of graders and rollers during the construction of the road. The bell and spigot joint preserves the alignment, and allows infiltration of water with less danger of the pipes choking up. Some engineers believe that best results are secured in this form of construction by laying the pipes with bells reversed.

All sewer pipe factories can supply second grade pipe, amply good enough for this type of construction, as defects which unfit the pipe for sanitary sewer construction are no detriment in underdrainage tile.

Surfaced Roads Would Save $23,000,000

This Amount Would Be Saved to Motorists in Decreased Gasoline Consumption Alone, Quite Aside from Lower Repair Expenses---Effect of Road Surfaces and Grades on Tractive Resistance

By **A. W. CAMPBELL**

Commissioner of Highways, Highways Branch, Department of Railways and Canals

In determining the amount of tractive force or "pull" required of animal or automotive traction to move a load over any road, there are three kinds of resistances to be considered, namely, rolling resistance, grade resistance, and axle resistance.

Rolling resistance varies depending upon—

(1) the diameter of the driving wheel;
(2) the number of revolutions per minute or hour of the driving wheel;
(3) the effectiveness of springs;
(4) the nature of the tires;
(5) the method of attaching tires to rims;
(6) the width of the tire in inches, and load per square inch;
(7) the degree of uniform hardness of the surface.

The most important of these factors in rolling resistance are Nos. 1 and 2, which determine the speed of the vehicle, and No. 7, which usually conditions No. 6. The width of the tire becomes of lesser importance as surfaces become harder.

Grade resistance varies also, depending upon—

(1) the elevation of the road, expressed as a percentage of the inclination or rise from datum; and,
(2) the weight of the load in pounds.

Like rolling resistance, grade resistance is a force expressed as so many pounds.

The latter is determined by multiplying the weight of the load expressed in pounds by the amount of grade expressed in hundredths.

Axle resistance is due to the condition of the bearing surface, the value of the lubrication, etc. For a wagon it amounts to three or four pounds per ton. But in the case of automotive traction, this resistance is negligible.

Tractive resistance is then the sum of the rolling resistance, and the grade resistance. It is expressed by the formula $R=F+aW$, where F equals the force required to draw a load on the level, A equals the grade expressed in hundredths, W equals the weight of the load expressed in pounds, and R the total force required to draw a load along a given piece of road.

Tractive Effort

Various experiments have been made by different authorities with a view to determining the amount of "pull" necessary over level stretches of different types of roads, different standards of condition of the same types, and over different grades. The results of these experiments have often varied widely. The explanation is in part that the same governing conditions have not obtained, in the different experiments. Factors in rolling resistance, such as Nos. 1 to 7 inclusive, above have not been identical. Again the classification of the types of roads used in experiments bears upon the results obtained. A good road in one section may not be so regarded in another section.

The results of a series of experiments with average conditions conducted by a reliable authority to determine resistance to automotive traction, using a light commercial vehicle, over different types of "improved" roads and the resultant consumption of gasoline, at average rates of speed, are summarized below:

Type of level road	Pounds pull per ton load	Miles per hour	Miles per Canadian gallon
Improved earth	92 to 218	4.6	6.93
Improved gravel	78 to 81	9.5	8.62
Water-bound mc'dm ..	64		11.38
Paved surface	27.6	16.4	13.90

It will be observed that the excess of mileage made per gallon of gasoline is considerable for each type of improved road, over that made over the lower type. Twice the distance was made for the same amount of gasoline used, in travelling over the paved surface than in travelling over the improved earth road. In other words the saving of gasoline as between these two types of roads is approximately 50 per cent. Similar experiments have placed the saving in gasoline consumption, depending upon the various factors in resistance entering into the experiments, at 20 to 60 per cent.

Having no regard to the "bad-road" taxes motorists are called upon to pay in the form of repair expenses, nor to other necessary expenses in the operation of motors, the extent to which every operator of an automobile is interested in road conditions may be illustrated by a few simple calculations. Assuming that the average operator travels in a season 5,000 miles, if he makes, say, 10.15, or 20 miles per gallon of gasoline, his purchase during the season, at 40 cents per gallon, will amount to a sum ranging from $200 to $400. Hence it is clear that were all the roads over which he operates his car uniformly good, his annual saving would amount to at least $50 for this item alone.

Saving in Gasoline

Should all the main-travelled roads of the Dominion be given hard surfaces, the annual saving to the 460,000 odd registered owners of motor vehicles in Canada, assuming that all users would participate in the benefit of the improvements, based upon the above conservative estimate, and having no regard to savings from lubrication and repair expenses, would amount to $23,000,000.

There is a comparatively light registration in Canada of the heavy types of commercial and passenger motor vehicles. The explanation is, in part, that where good roads are not assured for a full open season, the necessary investment in the more powerful and capable vehicles is too large to warrant prospective owners in being liable to have such rolling stock out of use, through being stalled in bad roads, or requiring overhauling by mechanics. Heavy vehicles are handicapped to a much greater extent than the lighter types; consequently, the costs of operation of the former through bad roads, particularly in hilly districts, are proportionately greater.

The ruling grade sought by road-builders in level country is about 2.50 per cent, that is to say, an average rise and fall of one foot in forty feet; in hilly country, it is about 5 per cent; and in mountainous country it is about 7 per cent. However, providing roads are hard surfaced, grades as high as 10 per cent, can be easily surmounted by any of the least powerful motor vehicles.

Determination of the grades upon different types of road surfaces, upon which operation of motor vehicles ceases to be economical, is a matter that as yet has not received the attention of highway and automotive engineers, and of the public interested in the progress of transportation facilities, that is desirable. For while the economical operation of all carriers depend upon the conditions of the highway avenues of travel, in a country with as much undulating territory as Canada the determination of a ruling grade that is satisfactory to operators of long-distance automotive equipment is necessary data precedent to the commencement of a national programme of highway improvement.

Effect of Grades

The following table gives the amount of tractive force required in comparison with a level grade force, for grades up to 10 per cent, together with the equivalent lengths of roads, as on a level road, first-class condition, in tractive force, to pull a ton:—

Per cent of grade	Rate of inclination	Tractive force in pounds per ton	Equivalent length
0.00	level	38	1.00
0.20	1 in 500	42	1.10
1.00	1 in 100	58	1.52
1.25	1 in 80	63	1.66
1.67	1 in 60	71	1.87
2.00	1 in 50	78	2.05
2.50	1 in 40	88	2.31
3.33	1 in 30	104	2.73
4.00	1 in 25	118	3.10
5.00	1 in 20	138	3.63
6.67	1 in 15	171	4.50
10.00	1 in 10	238	6.26

Comparing, e.g., the equivalent lengths in tractive forces, as on level grades, requirtd on 5 per cent and 2.5 per cent grades, namely, 3.63 and 2.30 times the level tractive force, it is seen that the former is 57.8 per cent greater than the latter. Hence, to this extent the costs of operation of motor vehicles are greater over hill roads than over the common roads.

For fast and light traffic, it is desirable that grades do not exceed 2 per cent, which amounts to a rise of 105.6 feet in a mile. Grades from 2 per cent to 3 per cent are acceptable for ordinary traffic. But where the natural grades are greater than 5 per cent, it is desirable that traffic censuses should be taken before the improvement of a highway is begun, to learn the comparative amounts of fast and slow and automotive and animal-drawn traffic using or likely to use the improved road. The amount of justifiable expenditure in grade reductions, and the advisability of seeking a new location, having regard to the predominance of a given class of traffic, are important considerations in the general public interest.

Fire Prevention and Fire Protection in Relation to Water Supply

By FRANK C. JORDON

Before American Water Works Association

Regardless of insurance, when a fire occurs everybody loses. American fire losses are about $5 per capita, European countries show losses of only $0.11 to $0.60. Over 80 per cent of the fire losses in America are preventable. The causes of these great losses in this country should be studied and a preventive campaign should be marked out, the latter to include legislation entailing personal liability for preventable losses. In many countries, the man in whose building a fire occurs must prove he was not responsible for the fire or forfeit his insurance.

A high fire loss in a city raises a question as to the integrity of the water-works just the same as a high typhoid fever rate raises a question as to the quality of the water supply, and therefore, the water authorities should aim to put down fire losses. In Indianapolis we have a fire prevention committee of 3,500 members, with representatives from every part of the city. The city is backing the work. The schools are used in the campaign.

The fire loss curve in Indianapolis had been going up steadily for years, as is true in other cities. In the year 1921 the Indianapolis fire loss decreased 36 per cent compared with 1920.

The committee has secured an agreement from roofers to charge reasonable prices for putting on fire-resisting roof coverings and to adopt a one-dollar-down deferred payment plan.

Motor Vehicles in Canada

During 1921 the number of motor vehicles registered in the Dominion of Canada was 463,848, an increase of 48,580 over the registration of the previous year. The revenue derived from motor vehicle licenses amounted to $7,569,493, representing an increase of 27 per cent. over 1920 revenue. All of this money is being applied by the different provinces toward the financing of the cost of constructing, improving and maintaining roads. The number of trucks registered was 31,092. The number of persons per vehicle varied from 12 in Saskatchewan to 51 in Prince Edward Island and the Yukon. The average for the Dominion was 19. By provinces, the registration was as follows: Ontario, 206,515; Saskatchewan, 61,175; Quebec, 54,660; Alberta, 40,292; Manitoba, 38,632; British Columbia, 32,850; Nova Scotia, 14,275; New Brunswick, 13,611; Prince Edward Island, 1,757; Yukon,81.

Conduct Investigation into Town-planning

According to the request of those interested in town planning, that a committee of the Legislature look into the subject, Premier Dury of Ontario on May 30 introduced a motion that such a committee be appointed with power to sit during the recess The committee, it is understood, will go into the whole subject of town planning. The members of the committee are: Hon. Walter Rollo, Minister of Labor; Hon. George S. Henry; Charles Swayze, J. B. Cunningham, Edgar Watson, A. G. Tisdelle, Joseph Thompson, J. C. Ramsden, Toronto; J. A. Pinard, G. G. Halcrow.

Plasticity is the Chief Purpose of Hydrated Lime in Concrete

Engineer's Report States That the Chief Merit of Lime in Concrete is the Production of a Smooth, Workable Mix—Reduction in Strength is Unimportant

The subject of hydrated lime in concrete has been receiving much attention during the last several years. Numerous experiments have been conducted with the object of determining just what effect hydrated lime has on concrete. Some of these experiments have indicated negative results, but many others have furnished positive proof that the addition of limited amounts of hydrated lime was decidedly beneficial to the concrete.

In general, however, experimenters, as well as the men on the job, have found that the use of hydrated lime materially improves concrete. Although the laboratory investigates concrete with the idea of determining its strength under various conditions the contractor is much more interested in how concrete may be placed with a minimum of time and labor. Hydrated lime holds many points in its favor, and through them, concrete may be greatly improved.

Many engineers and research laboratories have have given careful thought to the use of lime. The result of this thought and investigation has been that more and more engineers and architects are specifying the addition of hydrated lime in all concrete. Contractors are using it, not only when formally specified, but also at their own expense.

Advantages of Hydrate

From the engineers' viewpoint the advantages obtained from hydrated lime in concrete are numerous indeed. It makes possible the chuting and placing of drier concrete. It produces water-tight work, with smooth surfaces. Segregation and honey-combing are practically eliminated if hydrated lime is used. The volume changes due to variations in the moisture content of the concrete are greatly reduced. One investigator finds that the changes in concrete in which hydrated lime was used are approximately one-twentieth as much as those in plain concrete.

E. S, Dorr, engineer-in-charge of special work for the Sewer and Sanitary Division of the Public Works Department of Boston, Mass., has spent forty years in the department, and during this time he has devoted much time and thought to the matter of securing the best possible concrete. He has done much experimenting with hydrated lime, and his opinions are based upon both his long experience and his careful investigations. Mr. Dorr recently made a report on the use of hydrated lime and submitted it to his department. The report follows:—

The use of hydrated lime in concrete has been the subject of controversy for many years, and is yet. The reason is, I think, that the opponents are working at cross purposes, the issue is not clearly defined. Opponents to its use base their argument upon the loss of strength, which is the immediate effect; proponents rely upon the general improvement in the quality of concrete under ordinary service conditions, claiming that this overbalances the initial loss due to the addition of a material which is inert in respect to binding qualities.

Arguments for and Against Hydrate

The arguments against the use of hydrated lime in concrete are:

(a) That it impairs the strength of concrete and therefore, is a useless expense.

(b) That the same amount of money spent for additional cement would increase the strength of concrete.

The arguments in favor of the use of hydrated lime are:

(c) That it increases the density of the concrete.

(d) That it is a fairly good waterproofing agent.

(e) That free lime protects the steel reinforcing.

(f) That it produces a condition of plasticity, or ability to flow easily without an excess of water; this, to my mind, is the governing consideration.

The two objections (a) and (b) may be dismissed with the statement that they are not pertinent to the principal point (f); hydrated lime is not and never should have been added for the purpose, primarily, of increasing the strength of concrete. Moreover, while generally true, the objections are relatively unimportant with the amounts of hydrated lime which should be used which should not exceed 10 per cent by volume of the cement, added to, not replacing, the cement.

The reduction in strength of concrete is 0.59 of 1 per cent to 1 per cent, for each 1 per cent of hydrated lime added (by volume), according to Professor Abrams.

This is true if enough water is also added to produce the same consistency, as shown by the "slump test." If water is not added, the concrete is stiffened and the strength increased (by virtue of the reduction of water ratio) 0.51 of 1 per cent added. This point should be kept in mind, because it will have a bearing on the subsequent discussion. Water might not have to be added.

Increased Strength not Primary Object

The objection stated in item (b) is strictly true, but aside from the point, because increased strength is not the object sought. However, to make this statement more complete the figures may be given. Added cement increases the strength of concrete 1 per cent for each 1 per cent added, in case water is also added to keep the consistency constant. In case water is not added, the increase in strength is from 2.25 per cent to 2.58 per cent for each 1 per cent added.

The actual figures are as follows: 10 per cent of the volume of cement, the maximum, in a cubic yard of concrete is 0.57 cu. ft., weighing 22.8 lbs. (high calcium lime, 40 lbs. per cu. ft.), costing 21.7 cents at $19.00 per ton. 21.7 cents buys 3.10 lbs. of cement (376 lbs. at $2.75 per bbl., 0.7 cent per lb.) or 0.5 per cent of 564 lbs., 1½ bbl., in a cu. yd. of concrete, 1:2:4

mix. Increase of strength 0.5 to 1.4 per cent according to the use of water as above.

Cost of Using Hydrate

The cost of adding hydrated lime is partly offset by the increase in the volume of the concrete. For ordinary mixes this amounts to 60 per cent of the volume of the lime added; 60 per cent of 0.57 cu. ft.= 0.34 cu. ft. Assuming concrete to be worth $9.00 per cu. yd., 1 cu. ft. is worth 33 cents, 0.34 cu. ft. is worth 11 cents, or half the 22 cents, cost of lime per cu. yd. of concrete as above, so that the net increase in cost is only about 1 per cent.

All the statements of physical facts above and those to follow, except money values, are derived from the experiments of Professor Duff A. Abrams, in charge of the Structural Materials Laboratory of the Lewis Institute, Chicago, whose experiments and theories are the latest, the mose complete, and scientifically up-to-date.

Of the arguments in favor of the use of hydrated lime items (c) and (d) may be considered together; they relate to density and waterproofing quality. Not much light is thrown upon these subjects by the Abrams' experiments. Substantial increases in yield are accompanied by the same or slightly decreased density, apparently without relation to the wetness or dryness, or richness or leanness of the mix. Professor Abrams' definition of density is the "ratio of the total volume of solids in the mass to the volume of the concrete." The volume of a 10 per cent addition is small, 0.57 cu. ft. in a cubic yard, and the material is exceedingly fine. It seems probable that variations in the percentage of voids in the aggregate overbalance the effect of the addition of this fine powder.

Hydrated Lime Fills Voids

The effect of hydrated lime as a waterproofing agent was not studied. It is quite possible that an increase in water-tightness might accompany a decrease in density, as defined, if accompanied by an increased yield, particularly in a concrete with a coarse fine aggregate, because the lime would fill some voids.

Item (e).—There seems to be little doubt that lime preserves the steel in reinforced concrete from oxidation. Calcium hydrate or hydrated lime is the agent upon which the steel preservative compound "Tockalith" depends, as stated by the manufacturers.

Smooth, Workable Concrete

Item (f) describes the principal merit of hydrated lime, the power of conferring upon concrete the quality of plasticity (what the mason calls "fatness" in mortar) or ability to flow easily in troughs or chutes, and between and around reinforcement.

This is in practice a very valuable quality, because it removes or minimizes the temptation to overdose with water to produce the same effect. The impairment of strength which comes from the use of even a small excess of water is the outstanding fact brought out by the Abrams' experiments, and is emphasized by him.

The following quotations show the importance of keeping down the water content to the minimum consistent with proper plasticity:

Importance of Low Water Content

"With given concrete materials and conditions of test the quantity of mixing water used determines the strength of the concrete, so long as the mix is of a workable plasticity.

"In certain instances a 1:9 mix is as strong as a 1:2 mix, depending only on the water content. One pint more water than necessary to produce a plastic concrete reduces the strength to the same extent as if we should omit 2 to 3 lbs. of cement from a 1-bag batch.

"In other words, increasing the mixing water 13 per cent causes the same reduction in strength as if we should omit 33 per cent of the cement.

"The use of a coarse, well-graded aggregate results in no gain in strength unless we take advantage of the fact that the amount of water necessary to produce a plastic mix can be thus reduced. In a similar way we may say that the use of more cement in a batch does not produce any beneficial effect except from the fact that a plastic workable mix can be produced with a lower water ratio."

And finally the general rule is: "Use the smallest quantity of mixing water that will produce a plastic or workable concrete."

Hydrated Lime Reduces Water Required

This is exactly the function of hydrated lime in concrete, to produce a plastic mass with a minimum water content.

But strength is lost by the addition of hydrated lime. Strength is also lost by the addition of water. It comes down to a question of which way the most is lost in ordinary practice.

Assuming that Professor Abrams' results are correct, for ordinary mixes and consistencies the addition of 10 per cent hydrated lime reduces strength 5.9 to 10 per cent, or with a concrete of normal strength of 3,000 lbs., 177 to 300 lbs. It would seem that very much more might easily be lost by the addition of indeterminate quantities of water to make concrete sloppy enough to run freely. The paragraph in which it was stated that an increase of 13 per cent of water causes the same reduction in strength as though 33 per cent of the cement had been omitted, was preceded by another, to which it referred, which reads as follows:

"For instance, if the water were increased to a relative consistency of 1.25 (not nearly so wet as is frequently seen in road work) the strength will be reduced to 2,700 lbs. per square inch—a reduction of over 20 per cent." The increase was from consistency 1.10 to 1.25 or 13 per cent. A reduction of 20 per cent is 675 lbs., from 3,375 to 2,700.

It is unfortunate that the Abrams' experiments were not made with this specific point in view, to determine which of the two methods of obtaining the ability to slide in a metal chute is the better, whether by adding hydrated lime or by adding water. A very large proportion of all concrete is deposited through chutes, and and the flatter the angle at which it will slide the better.

Two kinds of tests were made to determine the effect of hydrated lime upon "plasticity," one the ordinary "slump" test, the other a "flow" test, which may be considered an intensified slump test. It was made by raising and dropping the table, upon which the slump test had been made, 15 times in 8 seconds, and getting the ratio of the diameter of the circle to which the material spreads to the diameter of the original base of the column. The results were irregular, but indicated a slightly increased "flow" with hydrated lime for lean mixes only. But this is not the kind of flow that we desire information about, and may, or may not, furnish any indication of it.

A series of experiments at different angles of inclination of the chute would be necessary to determine this point definitely. My own observation is that hydrated lime does confer this quality of flowing, slipping or sliding at flat angles, by reason of the "fatness" or greasiness which it gives to mortar.

Addition of Hydrated Lime is Good Practice

My own opinion is that it is good practice to add hydrated lime in mixing concrete in volumes not exceeding 10 per cent for the following reasons:

1. That it waterproofs the concrete to a greater or less extent, and being an integral waterproofing, thereby diminishes the swelling and shrinking of concrete due to moisture and dryness, which produces injurious initial strains in both steel and concrete.

2. That it protects the steel in reinforced concrete from rust.

3. That by imparting the quality of slipperiness to concrete, it removes the inducement to overdose with water (now the foreman's first recourse when concrete fails to flow freely in a chute), the net result being that under the ordinary conditions of practice, a stronger and better concrete would be produced, due to low water content, and absence of segregation of the aggregate (which happens in sloppy concrete), despite the loss of strength due to the addition of the inert lime, and that these results are obtained at an increase in cost of only about 1 per cent.

In other words, that while there is an initial loss of strength and increase in cost of concrete by the use of hydrated lime, these are negligible compared to the improvement in quality, increased imperviousness to moisture to whatever extent this obtains, and the protection afforded to the steel reinforcement against oxidation. This first reason is the most important, and, in my opinion, justifies the use of hydrated lime, in the prroportions mentioned.

Additional Facts About Lime in Concrete

Many phases of the use of lime have been presented in the foregoing report. One phase, however, of its use in concrete, has not been discussed, viz., that hydrated lime acts as a stabilizer of the moisture content in concrete. "Construction Lime News" published by the National Lime Association, points out that this is of great importance in construction, for stresses due to variations in the moisture present in the concrete are not at present taken care of by any reinforcing. Stresses due to temperature variation are easily computed ,and are provided for in the design of all large structures. For a great many years internal stresses caused by temperature variations were not considered as of sufficient importance to require special reinforcing. Investigation, however, disclosed the fact that these stresses were much greater than was anticipated and that they caused serious cracking of the concrete with the result that now every structure exposed to the weather carries special reinforcing designed to prevent cracks due to expansion and contraction caused by variations in the temperature.

Volume Changes Due to Moisture

Recent experiments have developed the fact that volume changes in concrete, which are caused by even slight changes in its moisture content, are many times greater than those caused by temperature variations. Such changes are, of course, sufficient to cause cracks or spalling if not provided for.

Methods of Providing for Moisture Changes

There are two ways of meeting the problem, which has thus been brought to the attention of the profession. One way is to compute the stresses developed and introduce steel to take care of them. This, of course, is extremely difficult, as different mixes and varying conditions introduce elements over which the engineer has no control, and consequently cannot accurately determine how to provide for them.

The second method of providing for volume changes due to moisture is to eliminate them as nearly as possible, and then disregard the remainder, which may be considered negligible and easily taken care of by the inherent strength of the concrete. It is a simple thing to add a comparatively small amount of hydrated lime or lime putty to all concrete. This lime acts as a stabilizer of the moisture in the concrete and tends to hold the moisture content practically constant. If the moisture present is held constant, these valume changes, so difficult to compute, will not take place, and consequently may be disregarded.

The lime functions in two ways. It holds the water remaining after the permanent set has taken place practically constant, due to the fact that evaporation of the moisture present is extremely slow. Secondly, the voids and pores which exist in well-mixed concrete containing lime are so infinitesimal that penetration of moisture from the outside is comparatively slight, and complete penetration, or leakage is impossible.

Lime Minimizes Volume Changes Due to Moisture

The most striking proof of this development according to the Lime Association is a series of experiments soon to be published, which indicate that the volume changes due to variation in the moisture content of concrete containing hydrated lime are only about one twelfth to one-twentieth as great as the changes that take place in similar concrete, laid under similar conditions, but without the addition of lime.

Clay Products Bulletin

"The Pyramid" is the title of a bright little house organ which is being issued by the Vitrified Clay Pipe Publicity Bureau, Toronto. It serves to present in a popular fashion the uses and advantages of vitrified clay pipe. In the first issue of this publication, dated June, special emphasis is laid on the permanence of vitrified products.

Building is Active in Lachine, P. Q.

Reports to the Contract Record from many sections of the country show that business in the construction line is quite active—in many cases much in excess of past years. For example, Andrew Henderson, general building contractor of Lachine, P. Q., reports that business in his line is exceptionally good—"better than for years." F. C. Brunet & Son, building contractors, Lachine, P. Q., also report plenty of work. This firm is erecting a building containing two stores and four flats, at a cost of $30,000, and also a one store and two flat building at $8,000.

The Fireproof Qualities of Pressed Steel Construction

By **A. H. BROMLEY**

There seems to be either a lack of general knowledge relative to the fireproof qualities of pressed steel, or else a tendency to refuse to recognize the merits of this construction on the basis of knowledge, acquired by records of tests and performance in years of service, which standard is the one by which other constructions are rated.

The record of pressed steel construction and its component parts in service and under fire, shows that they have been proven equally as good, and, in fact, better than other types of construction which are recognized as standards. This construction has satisfactorily passed a number of fire tests without injury to the structural members, and to-day stands practically alone with a record of having been in active service for many years without a failure.

To determine the true value of a product or a construction, it is first necessary to make a study or an analysis of its component parts, because only insofar as the materials of a construction are consistent, can the whole be sound.

There are two types of fireproof building structures. One in which the materials are formed or fabricated into unit sizes or shapes, and installed in the building on the basis of individual units. These units are secured in the structure by mortar, or by standard field connections made of the same material as the unit itself. Another type is that in which materials of various kinds are taken to the job and mixed into concrete or the like, and poured or cast in place in forms previously erected to retain the soft mixture, the forms being removed after the material has hardened or set.

In the structure formed of this latter class of materials, there is a mixture of materials of radically different nature, such as scientifically produced portland cement and steel reinforcing bars, which products are incorporated with sand, gravel or broken stone and water.

These structures at their best are subject to the variations of composition, size, etc., which is characteristic of materials taken from river beds, sand banks or stone quarries.

Therefore, while materials of highly refined quality enter into the composition of these structures, the addition of large quantities of water and unrefined sand and aggregates, together with the uncertain human factor involved in mixing and installation produces a structure in which there are many uncertain values.

This fact is not only proven by inspection of structures, but also recognized by authorities, and various national societies are now struggling with the proposition of trying to prepare regulations, and provide safeguards to minimize the uncertain results so prevalent in this type of building construction.

While component and thorough inspection is necessary in all building constructions, there are decided advantages in the use of materials installed in units, which units can be inspected and their sound qualities verified before or during installation.

Timber for wood construction can be carefully selected and erection details carefully checked. And in the case of rolled steel and pressed steel members, the material is a refined, scientifically fabricated product, and careful inspection after installation is all that is required to insure a structure of adequate strength and safety.

A careful analysis of the pressed steel type of fireproof construction and its component parts reveals the following: The load carrying members are units composed of pressed steel joists made of the highest grade and most thoroughly worked steel used in building construction, and of analysis similar to that of structural steel. These joists are covered with 2 inches of concrete, and protected on the under side with metal lath and plaster, as shown in the illustration.

The first step in the manufacture of either cast iron, structural shapes or pressed steel is the reduction of the ore to the pig iron.

Cast-iron, however, does not receive the careful refining and thorough melting of the open hearth process.

The pig iron (or molten metal and limestone flux) is placed in an open hearth furnace, and the high temperature causes the removal of the excess carbon and other impurities.

When the process is about completed, samples are taken and the chemical analysis of the bath determined so that the charge may be drawn off at the proper time and cast into ingots. The ingots after reheating are run through rolls, forming blooms or billets for rolled beams, or long rectangular shaped sheet bars or slabs for pressed steel sheets or strips.

The blooms or billets are then rolled by successive reductions into beams of standard section, while the sheet or strip bars are cut into proper lengths, reheated and rolled into sheets or strips.

Pressed steel sheets or strips are not at any time, after the formation of the ingot, rolled into other than flat sections of uniform thickness, thus eliminating tendencies to the introduction of internal stresses.

Strip steel cannot be rolled when the temperature of the metal has dropped below about 1300 deg. F., therefore, there are no tendencies to the introduction of internal stresses from the rolling, and sheets, which can be rolled at a lower temperature, are blue annealed, and this annealing eliminates all internal stress. As a result of this absence of internal stress these materials will withstand high temperature even to practically the softening point, without twisting or other deformation. In this respect they are different from rolled structural steel shapes and therefore need less protection from fire than other steel products.

The above stated facts are proven by the temperature of 1046 deg., F., which was recorded between joists in the satisfactory test conducted by Jas. S. Macgregor, M. S., in co-operation with the New York building bureaus, and by numerous tests by manufacturers of unprotected joists in annealing ovens at even higher temperatures.

Pressed steel joists are not only superior as to fire-resistive qualities but are of proven sound quality by reason of the process of fabrication, because the joists cannot be successfully formed from defective or imperfect material.

Steel joists are installed bearing on brick walls or structural steel or reinforced concrete beams in the usual manner, and protected on the upper side by a reinforced concrete slab about 2 inches thick, and on the under side by a metal lath and plaster ceiling as shown in the illustration.

After the joists are secured in place, expanded or ribbed metal lath is installed over the entire floor area, this metal lath serves both as a centering on which to pour, as well as a reinforcing for the concrete fill.

When wood floors are used, 2 by 2-in. wood sleepers are first nailed or secured by metal clips to the tops of the joists, over the metal lath, and the concrete fill is poured between the sleepers.

The flanges of the joists are in no case less than 3 inches wide, thus providing a shoulder or projection at the outer edges of the flange, which forms side bearings for the concrete slabs between sleepers. When composition or cement finished floors occur, the wooden sleepers are omitted and the concrete poured in an unbroken sheet.

The ceiling of the apartment below is formed by securing ribbed metal lath to the bottom of the joists by means of prongs or clips, and using this metal lath as a base for plastering in the usual manner.

The kind of plaster used should be determined by the fire hazard involved in the building in question.

In view of the fact that fire tests have been made by the Underwriters Laboratories, the results of which indicate that lath and either gypsum or portland cement plaster, will protect the under side of wood joists covered with a wood floor for about an hour, when subjected to fire according to the stand ard time temperature curve, it is evident that steel lumber construction, consisting as it does, of incombustible joists and a wood flooring protected by concrete should be rated as fireproof.

Three successful 4-hour tests have been made on metal lumber construction, and an extensive series of tests were made in August, 1919, wherein different kinds of sand, secured from different parts of the country were made into portland cement mortar and plastered on metal lath panels and subjected to fire and water tests. These tests have demonstrated that any good clean sand may be used with equally good results, and also that metal lath and a portland cement mortar, even of lean mix, will withstand repeated exposures to fire followed by applications of water from a fire hose.

The splendid showing developed by a careful analysis of this construction, and with due consideration given to the record of pressed steel and the other component parts of the structure, coupled with the fact that the various manufacturers have recently standardized their sections, places pressed steel construction in the front rank as an economical lightweight, quickly erected type of fireproof building construction.

The simplicity of detail in design, and a material as easy and cheap to erect as wood, really constitutes an incentive to build along these most desirable fireproof lines.

Design is simplified and standardized for the architect and engineer by the use of hand books published by manufacturers, which books rank with the well known structural steel pocket books which have served engineers for years.

Statistics show that about 95% of the fires originate inside of buildings. This shows that it is essential that more attention must hereafter be given to the fireproof qualities of the interior of the structure, therefore, this economical and effective pressed steel construction should not only be recognized, but should be actively encouraged by everyone who favors better buildings.—Engineering World.

Tests on Sea-water Corrosion of Structural Materials

An important part of the work of the committee appointed by the Institution of Civil Engineers six years ago to investigate the deterioration of structures exposed to sea action concerns the corrosion of structures involving the use of ferrous materials, and in a paper read before the institution Sir Robert Hadfield, who was consulted as to the most desirable materials for testing, described the various types he recommended for the purpose.

The materials he selected fall into four classes and comprise 14 different varieties. There are three rolled and forged irons (wrought iron, Swedish cast iron and Armco iron); four carbon steels (mild steel with low manganese and high sulphur and phosphorous mild steel with 0.70 per cent. manganese, medium carbon steel with low sulphur and phosphorous, and carbon steel with 0.40 per cent. of carbon); five special steels (mild steel with 0.50 per cent. of copper, mild steel with 2.0 per cent. of copper, 3.50 per cent. nickel steel, 36.00 per cent. nickel steel, and 13.50 per cent. chromium steel, known as non-rusting steel); and two cast irons (cold blast and hot blast).

Preparation of Test Pieces

All the specimens, except those of cast iron, were prepared in the form of rolled bars, and in every case they are 24 in. long, 3 in. broad and ½ in. thick. Each of the materials was prepared in the condition "as rolled," that is, without further heat treatment, because it was thought best that the tests should be carried out on steel as nearly as possible resembling that met with in constructive work. In general also the oxide skin produced in rolling, or in the case of the cast iron, the casting skin was retained, but to obtain some information as to the effect of this skin in regard to corrosion, an additional set of specimens was prepared in the case of two of the carbon steels from which the skin was removed by grinding all over. Further, one of the bars of each material, except the cast irons, was heat treated to obtain test data representing the materials in the best possible condition.

In all, 1,330 separate specimens have been prepared, and 955 have already been allocated for test, the remainder being held in reserve. Of the 955 the majority are to be sent to various stations at home and abroad to be immersed in sea water, but 182 of them have been subjected to tests by Sir Sobert Hadfield in his laboratory. These tests, the results of which are discussed in the paper, included analyses for all the elements present, tensile tests on test bars cut in the longitudinal direction, Fremont shock tests in both the longitudinal and the transverse directions, Izod shock tests in the longitudinal direction and Brinell hardness tests. Photo-micographs were taken in both the longitudinal and transverse directions, and in the case of a certain number of tensile test bars from the various specimens, detailed elongation figures were obtained, partly with the object of ascertaining the effect of strain on the corrodibility of the different types of material. Some data adduced for Armco iron show that the strained material is more subject to corrosion than the unstrained, and reasons are given for thinking that the resistance of non-rusting steel to corrosion when almost constantly wetted by sea spray depends on its physical constitution. One set of test bars is to be immersed in the sea at Plymouth, to see whether the mechanical properties are impaired by long immersion.

The pieces that are to be exposed to sea action (at Plymouth, Auckland, Colombo and Halifax) include plain bars, riveted bars, bolted bars, bars of dissimilar material in contact, and pieces bent to test the effects of strain. In view of the possibility of very severe corrosion in some instances, the marking of the bars presented a problem in itself, since there was a risk of any ordinary marking being obliterated and of badly corroded bars, or portions of them, falling out of place. The method finally adopted was to distinguish the bars by the number and position of holes drilled through their ends.

Cost of Waste by Corrosion

In the concluding part of the paper the author, after discussing different theories of corrosive action and the behavior of special materials, attempted an estimate of the waste caused by corrosion. Taking the world's output of iron and steel during 1860-1920 at 1,860 million tons, he estimated that 400,000,000 tons by 1920 had been discarded as worn out or useless and 660,000,000 tons lost by rusting in use, so that the quantity in use was 800,000,000 tons. In the same year he put the production at 66,000,000 tons, the quantity worn out or discarded as useless at 17,000,000 tons, and the quantity lost by rusting in use at 29,000,000 tons, so that the net increase of iron and steel in use was 20,000,000 tons. At £20 per ton the 29,000,000 tons lost by rusting in 1920 represented 580,000,000 sterling, and including the cost of zinc for galvanizing, of brass and other metals for sheathing or as substitutes for steel, and of paint for protection, he put the total cost of corrosion in that year at well over 700,000,000 pounds sterling.—London Times Engineering Supplement.

Standardized Contracts

By F. M. Gunby before Boston Society of Civil Engineers

A standardized form of contract is desirable. My experience with the administration of the emergency construction contract during the war convinces me that this is so. That contract was used by the Construction Division for its work, covering a vast range of kind and amount of construction. Through the use of one standardized contract for all of its work, it was possible to get under way speedily, complete the work at costs for fees which were unusually low, and then to make settlements in practically all cases in a comparatively short time after the end of the job. Compared to the time required to make settlements on similar projects executed under contracts which were not standardized, the records for speed made with the standardized contract were remarkable.

Must be Fair to Both Sides

In order to be adopted as a standard, the contract should be fair to both sides, and should be in substantial agreement with existing practices, as, otherwise, the adopted standard will not be commonly used. Contracts are interpreted by ordinary men and the interpretation is about as important as the wording of the contract itself. For this and many other reasons a contract should be short and simple.

The contract form which I have examined, as being proposed, makes a good beginning for standardization. If we are to have a standardized contract, it is important to get as good a standard as practicable adopted after a reasonable amount of discussion and then, if necessary, to make improvements as we go along in practice.

This proposed contract seems to involve no new principles, being principally an adaption of two existing standardized contracts. It is long, and it seems to me desirable, if practicable, to shorten it. I believe the principle of dividing it into two parts—one to be filled in to fit the particular requirements of the job in hand, and the other of standard clauses covering principles which should not vary—would be a good arrangement.

Two Variations From Usual Form

The principles involved seem to me to be in nearly all cases about the same as those in the contract under which we have been having work done for many years. These are two points, however, which are different. The first, and the less important of these is the provision for the payment for materials stored on the site of the project. Our practice has been not to authorize such payments except under special conditions of unusual amounts on hand for good and sufficient reasons, or in case of unusual delays. The other point is the clause on arbitration. The proposed contract provides for a board for arbitrating everything except artistic effect. There are matters of engineering which I do not feel are subject to arbitration by a board any more than artistic effect would be. These are what I call "conception of design," having to do with the disposition of materials for reasons of design or for reasons involving the use of the structure, and should be subject to the control of the designer solely, as they are matters of educated judgment, and changes in them may involve serious changes in the efficiency of the design.

Arbitration Clause May Delay

I have discussed this matter with some other engineers and I find a distinct feeling that the arbitration clause in this universal agreement will create considerable argument. Some have stated that they feel that the arbitration clause will result in delays and inefficiency without compensating advantages.

There are engineers and architects who will be as impartial as any board, and others who will not be constituted. There are also engineers and architects who can not, on account of legal or other limitations, use the proposed arbitration clause. I suggest that the arbitration clause in the proposed universal agreement be moved into the first section of the contract, so that either the clause proposed or the clause providing for arbitration by the chief engineer or architect may be selected at the time of awarding the contract.

Orton & Steinbrenner Company, manufacturers of locomotive cranes, grab buckets and coal crushers, have moved their offices from the 11th to the 19th floor of the Transportation Bldg., 608 So. Dearborn St., Chicago.

The Contract Record's

Weekly House Suggestion No. 23

Hamilton, Ont., has many well planned homes, one of which is here illustrated. In the construction of this house very unusual attention was paid to the electric wiring, as builders are finding out that the public are to-day demanding homes better equipped in this respect. To the man who is building his own home, we would strongly recommend that he investigate the possibilities of a little added expense in electric wiring in the way of producing comfort and convenience. A home is something we live in for a long time, and the satisfaction of a properly wired home, so that it may be well and attractively lighted and so that the various labor-saving and comfort producing appliances now on the market can be readily used, will remain long after the original cost of the installation is forgotten. To the builder, we would strongly recommend that he take into consideration the added selling attractiveness of the home that is properly wired. Nowadays people are saying, when you offer a house for sale, "Is it well wired?" They used to ask about the heating, the plumbing, the ventilation, etc. To-day they are considering as of much greater importance—almost of primary importance—the necessity of a home well equipped electrically.

The builder of the Hamilton home had learned this lesson, as a study of the plan will show. From the outside it is an attractive though quite ordinary looking home, but inside it gladdens the heart of every woman who crosses the threshold. Convenience outlets are placed wherever they will save steps; outlets for decorative as well as utility lighting; telephone outlets in various rooms to eliminate continuous journeys to the telephone from a remote corner of the house; plans for ventilating the kitchen: A splendid scheme is the placing of the meter in wall so that it may be read from the outside, through a glass door. What endless vexations this saves the housewife! Lights are installed in the clothes closets—the darkest corners in the house—and in a dozen different ways electric wiring places this house on a high plane as a home in which to live.

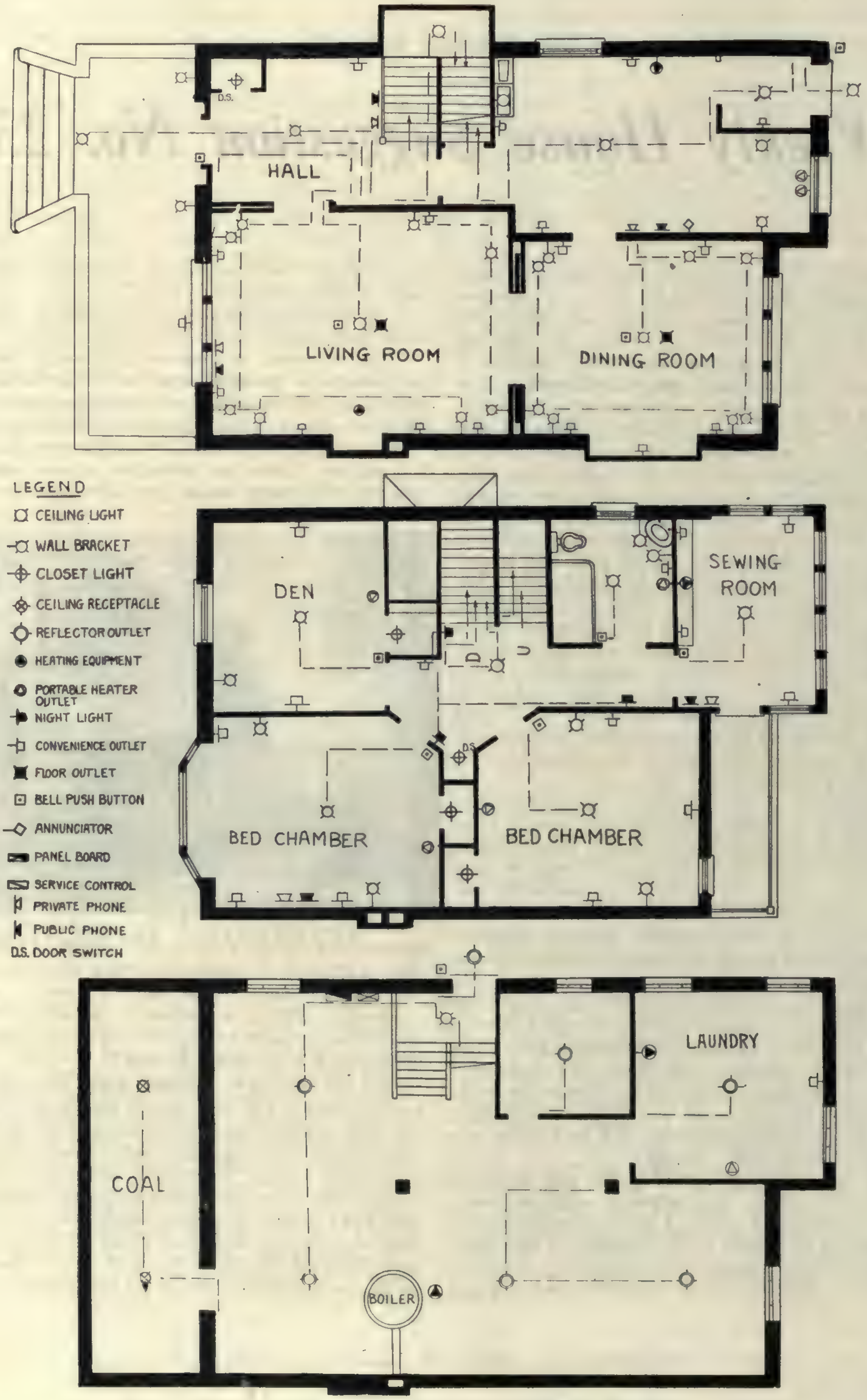
The cost of wiring a house in this way could not by any stretch of the imagination be called expensive. We think nothing of adding a few hundred dollars to the plumbing or heating so as to make it a little more efficient or more attractive in appearance, yet these refinements cannot compare with the same amount of money spent in better wiring, in added conveniences, comfort and satisfaction.

The difference between a house and a home depends quite largely on the electric contractor.

The argument is sometimes advanced that it is not possible to get the owner to see the advantages wiring job like the Hamilton job can be produced for about 5 per cent of the total cost of the house. What —to get him to consent to the added expenditure. A is 5 per cent of the total cost when it buys something you live with every day of your life; something that lightens the labors of the home: something that shortens the hours of labor; something that gives more time for recreation; something that yields you real comfort as well as convenience; something that enables you at small expense to live the modern way instead of the old fashioned way?

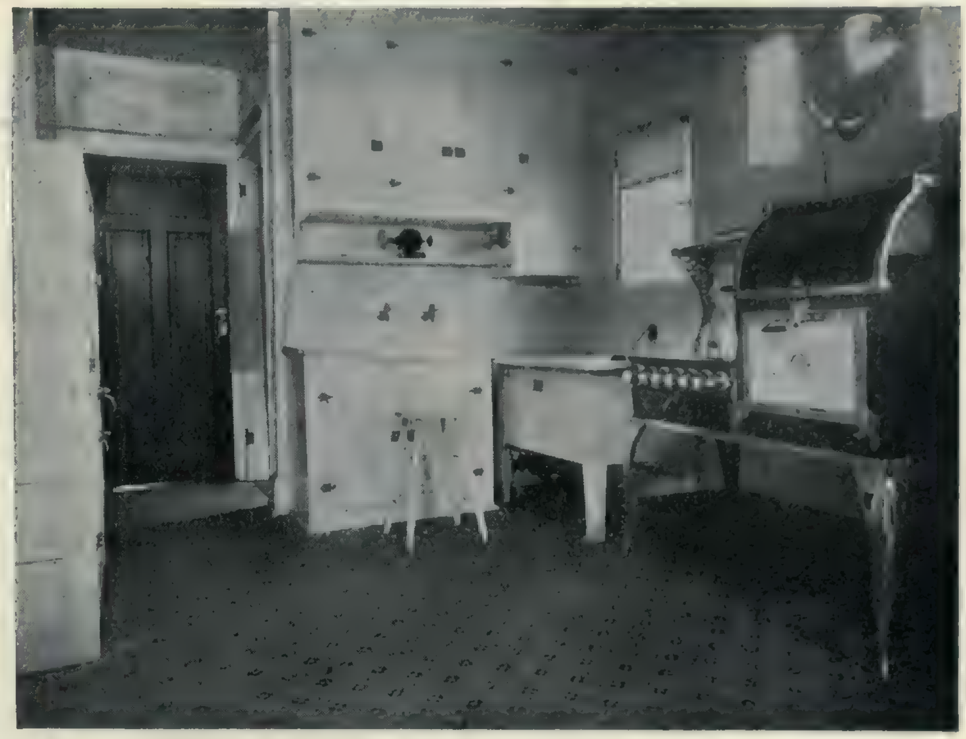
We ask builders to carefully study the plan shown herewith and see if they cannot incorporate some of the ideas contained there in the homes they have under construction today and will have under construction in the near future. If anything more can be said to convince the home builder that the public demand is for well wired houses, it is this: the builder of the home illustrated on this page, as a direct result of showing people through this home, has sold seven other homes on this same property, before the buildings are started.

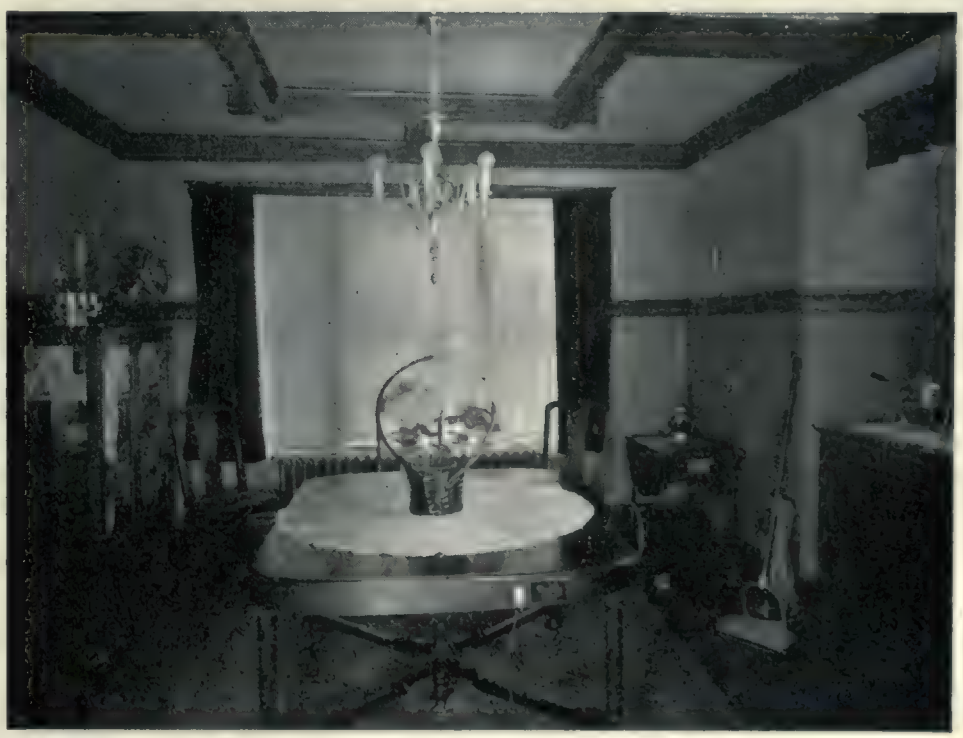
(For plans and photographs of the interior see next two pages)



Plans of Contract Record's house suggestion No. 23

This Hamilton Home with the Completeness of its Electric Service Offers Many Suggestions to Contractors





(For description and plans see two preceding pages)

The Building of Hard Surfaced Roads is a Manufacturing Proposition

Organization Counts in Getting Production—Machines and Materials Must be Properly Used—The Cost of Breakdowns and Poor Labor

The importance of taking proper care of road building equipment was pointed out by Mr. R. M. Gates, chairman Materials Handling Division of the American Society of Mechanical Engineers, in an address at the annual meeting of the Associated Pennsylvania Highway Contractors. We quote as follows:

The building of hard surface roads to-day is a manufacturing proposition. Here you take your factory to the point where your product is to be delivered. Even after you have moved your plant to the location, you are still compelled to shift it continuously, as the material is delivered. This method is the most trying, and invites greater hazards than any manufacturing enterprise.

The road-building shop, if we may call it such, is peculiar in that it has its machines and operations, also storage, along a narrow aisle in the "factory." Each operation is dependent upon some other operation, either ahead or behind it. The speed and quality of the work is also dependent upon the balancing up of the operators and operations. The personnel of the job controls the progress, for it is the men that man the tools that are responsible for the work. They, of course, must be properly selected and when at work must be supplied with proper tools and material to make the desired progress. The responsibility for this is with the management, and no one else.

The Organization That Counts

Some gangs with inferior tools have shown marked superiority in workmanship and cost of construction over others with highest types of machines. The tools are a big factor when properly used, but it's the organization that counts.

To me, this organization controls the situation. It will use wisely or unwisely the tools or machines furnished it, and the result of the job depends upon the combined efforts of all. Each tool will do certain things and must have certain care. If it be neglected, overlooked or abused by misuse, the result is not the fault of the machine, but of the organization and the management. If through neglect or abuse the machines fall down, they may be a greater liability than a profit. If the gang is not competent to handle machines, it should be given only tools that it can profitably work with.

All manufacturers design and build machines not only for the work they are supposed to do, but also for a certain amount of neglect and abuse. The machines are not perfect and never will be, but the manufacturer has made wonderful strides. The operators, however, have not kept step with him.

The tendency has seemed prevalent to employ low priced men, many with little experience, to do the actual building of road. With the advent of the more complicated specifications the management has changed to a much higher grade, until now we have some of our ablest engineers and business executives in this work. Many men on the job, however, are untrained and of very poor grade. This I feel is where the greatest mistakes are made.

Many superintendents and foremen refuse to recognize the fact that the limitations of tools depend upon the intelligence with which they are used, the work required to be within their power and that the proper care be given in their operation, lubrication and adjustments.

To-day there are a number of contracts that do not have a mechanic on the job. Many entrust the care and adjustments to a man whose only previous experience was to run a "flivver." Bearings and gears break because concrete is allowed to collect day after day; grease cups are broken off and the hole filled with cement. It is a wonder that there are not more breakdowns and greater losses.

Most of the delays now are, according to highway reports, due to breakdown of machinery. According to General Marshall in Washington, the average daily loss is approximately $500.00 per job on which operation is stopped. A fair share of these delays, I feel sure, could be avoided if the mechanics on the job were more competent.

Most manufacturing plants have trained men to operate machines and expert mechanics to make adjustments and repairs. But in your industry, where the conditions are many times more severe, you have poor labor as a rule for your operators, and often a master mechanic who is a local "Darius," whose whole experience has been with a hammer and a chisel, and who has fame as a tinkerer.

It can't be done at a profit. If you are going to limit your organization to cheap incompetent labor, you will limit your tools to the same as were used 20 to 30 years ago. Yes, even worse, for these high-priced material-handling machines will prove a lodestone on the job.

To get the best out of highly developed tools is to put men in charge of them that foresee breakdowns, who get maximum production every day. If you do this, you will have handsome returns, and the machines will surprise you with the way they will work.

278,160 Working Days Lost by Strikes During May

The time loss due to industrial disputes during May was less than during April, 1922, but greater than during May, 1921, according to reports received by the Department of Labor. There were in existence during the month 30 strikes, involving about 13,186 workers, with an estimated time loss of 278,160 working days. Ten of these strikes were reported as having commenced during May. Four of the strikes commenced prior to May and seven of the strikes commencing during May terminated during the month, leaving 19 strikes, involving 9,807 work people, on record at the beginning of June.

Mainly Constructional

East and West—From Coast to Coast

An expenditure of $125,700 has been approved by the County Council of Hastings, Ont., for road work during the present season.

The Council of Western Canada Municipal Union, representing the cities of Western Canada, held a three day session at Victoria, B. C., recently, for discussion of the problems of western municipalities.

It has been announced that the Lyall Construction Company of Montreal, was the lowest bidder on the contract for the construction of sections 3 and 4 of the Welland Canal and will likely get the contract.

The Better Homes exposition, at Hamilton, held during the week June 4 to 10, boasted an attendance for the week of about 60,000. The exposition was a success, not only from point of numbers, but from every other standpoint.

In the presence of a large assembly of prominent men. Mr. Hiram H. Walker recently officiated at the ceremony of christening the new Prince Edward Hotel at Windsor, Ont. The hotel was thrown open for public inspection for several hours in the afternoon.

The city council at Vancouver recently passed a by-law making it compulsory for all master plumbers to pass an examination before a board of examiners before being allowed a license to practice in the city. This action has been sought by the employing plumbing interests for the past seven years.

A grant of $500,000 has been made to the University of Toronto by the Legislature for construction work this year. This amount will be utilized in the following manner: Extension to the Women's Residence, $100,000; new Administration Building, $200,000, and new Forestry and Botany Building, $200,000. Sites for the two new buildings have not been decided upon as yet.

A new addition will be constructed to the collegiate institute at Galt, Ont., at an estimated total cost of $335,000. At a recent meeting of the city council it was decided to adopt the plan of issuing the funds for this work in blocks as required, the first installment of $100,000 being authorized at this meeting. It was thought that this latter amount will be sufficient to finance this year's work on the addition.

A movement is on foot, backed by the Chamber of Commerce, at Sarnia, Ont., to obtain government action on a proposal to link up the proposed provincial highway from Sarnia to Goderich with the existing scenic highway which follows the shores of Lake Huron north to Owen Sound, Georgian Bay and the Muskoka Lakes. It is anticipated that this would mean a large increase in the tourist traffic over the St. Clair River at this point.

The new sanitary sewer system for West London, Ont., is in the completion stages and it is possible that all house connections on this system will be made by the end of the month. The new system, which has been under construction for about a year, was estimated to cost $520,000, but although actual cost figures are not available just now, it is thought by Mr. Brazier, city engineer, that they will be considerably under the original estimate.

Several motorists took part in a motor "hike" from Stratford to Goderich, Ont., recently, in the interests of good roads. A dinner was tendered the visitors on their arrival at Goderich, followed by short addresses by Hon. F. C. Biggs, Minister of Highways; Hon. Peter Smith, Provincial Treasurer; Mr. F. Wellington Hay, leader of the Liberal Opposition in the provincial legislature, and several civic officials from both cities. The "hike" was held under the auspices of the Stratford Chamber of Commerce and was such a success that it has been decided to make it an annual affair.

The election of officers at the Canadian Good Roads Association's annual convention, held last week at Victoria, B. C., resulted as follows: President, Hon. J. L. Perron, Minister of Highways, Quebec; honorary president, Hon. S. J. Latta, Regina; first vice-president, Mr. Russell T. Kelly, Hamilton; second vice-president, Mr. F. L. Fellows, Vancouver; secretary-treasurer, Mr. G. A. McNamee, Montreal. The following directors were elected: Messrs. James Beaubien, Outremont, Que.; H. S. Carpenter, Regina; William Finlay, Toronto; George Hogarth, Toronto; J. D. Robertson, Edmonton; P. Philip, Victoria; S. H. Henderson, Winnipeg; G. Fred Pearson, Halifax; R. D. Patterson, St. John; A. M. Rankin, M.P.P., Collins Bay, Ont.; T. J. Mahoney, Hamilton; H. H. Shaw, Charlottetown, P.E.I.; J. A. Duchastel, Montreal; P. Gommoy, Vancouver; R. P. Murray, Halifax.

Personal

Mr. H. S. Van Scoyoc, director of publicity for the Canada Cement Company, Limited, Montreal, left recently for an extended tour of the West.

Mr. H. L. Bucke has been appointed general superintendent in charge of the canal and river sections of the Queenston-Chippawa power development.

Mr. J. C. Gardner was recently appointed road engineer for Welland County, Ont. Mr. Gardner is a graduate of the University of Toronto and a member of the Engineering Institute of Canada.

F. S. Altman has been appointed district engineer in charge of the Minneapolis Office of the Portland Cement Association, to succeed W. E. Hart, who has been transferred to the general office, as manager, Structural Bureau.

The Barnett McQueen Co., Ltd. engineers and contractors, with head office at Fort William, Ont., have opened a temporary office at Room 737, Can. Cenent Building, Montreal. Mr. E. D. Casseday, general manager, is at present at the Montreal office. They are engaged on the construction of an extension to the St. Lawrence Flour Mills.

Mr. R. L. Hearn, assistant of Mr. H. G. Acres, hydraulic engineer of the Queenston-Chippawa power development, has been appointed hydraulic engineer for the Washington Water Power Company, with head office at Spokane, Wash., and will shortly take up his new duties. Mr. Hearn is an associate member of the Engineering Institute of Canada.

The Hon. C. C. Ballantyne was recently elected president of the National Brick Company, of Laprairie, Ltd., Montreal, succeeding Mr. H. R. Trenholme, who is retiring from office as his private business will not permit him to give sufficient time to the duties involved. Mr. Trenholme, however, will remain a member of the board. Mr. Ballantyne is a director of the Royal Trust Company, Canada Cement Company, Montreal Locomotive Works, the Canadian Explosives, Ltd., and for many years has been vice president and managing director of he Sherwin-Williams Co., of Canada, Limited.

Incorporations

The Carswell Construction Company, at Toronto, has been incorporated as a limited company, with a capital of $100,000, and will continue to carry on a general contracting business.

CONSTRUCTIONAL ACTIVITY

Period of June 14 to June 20, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Alexandria, Ont.
Town Council will construct asphalt penetration pavement at cost of $10,500 on Kenyon St., work by day labor. G. H. Magwood, Engr., Cornwall, Ont.

Bridgewater, N. S.
Town Council contemplate Tarvia resurfacing King St. Jas. A. Purll, clerk.

Eganville, Ont.
J. S. McCann, clerk, has plans and will receive tenders until July 1st for construction of sidewalk.

Etobicoke Twp., Ont.
S. Barratt, Islington, Ont., clerk Twp. Council, will receive tenders until June 26th for waterworks. Plans with James, Proctor & Redfern Ltd., Engrs., 36 Toronto St., Toronto.

Fort Frances, Ont.
J. W. Walker, Town Clerk, will receive tenders until June 26th for construction of concrete pavements and for installation of water and sewer connections. Plans with MacLean Building Reports Ltd., 348 Main St., Winnipeg.

Kincardine, Ont.
H. Hurdon, Chrm. Waterworks Cmsn., will receive tenders until June 27th for slow sand filters and equipment for Town. Plans with F. W. Thorold Co. Ltd., Engrs., 54 Admiral Rd., Toronto.

Marieville, Que.
Town Council plan construction of roads. J. C. Ostigny, secy.

Montreal, Que.
City Council plan construction of sewers on Taillon, Besmarteau and Bernard Sts. at cost of $125,000. S. Fortin, Engr.

St, Fidele, Que.
Ovide Larouche. St. Fidele, will construct aqueduct at cost of $15,000.

Sombra Twp., Ont.
Jno. A. Huey, Sarnia, clerk Sombra Twp. Council, has plans and will receive tenders until June 28th for construction of concrete pavement. Plans also with Geo. A. McCubbin, Engr., Chatham, Ont., and Jno. McCallum, Road Sup't., Alvinston, Ont. Marked cheque for 5% of tender required.

Toronto, Ont.
W. A. McLean, Deputy Min. Dep't. of Pub. Highways, Prov. Gov't., has plans and will receive tenders until July 7th for roadwork. Plans also with the following Res. Engrs.: Dr. H. Philip, Toronto; A. L. Baldwin, Gananoque; A. Earchman, Carleton Place; D. W. Bews, Port Hope; W. F. Noonan, Napanee; H. A. Smail, Kingston; A. Timbrell, Simcoe.

Trafalgar Twp., Ont.
Roy F. Smith, Engr., Dundas St., Oakville, has plans and will receive tenders until June 26th for construction of concrete pavement for Trafalgar Twp. Council.

Verdun, Que.
City Council will pave Verdun and Mullarkey Sts.

West Nissouri Twp., Ont.
J. H. Davis, R. R. No. 1, Bolton, Ont., clerk West Nissouri Twp. Council, has plans and will receive tenders until July 3rd for drainage system.

CONTRACTS AWARDED

Black Lake, Que.
J. Duquet, Black Lake, has general contract for gravelling road for Town, at cost of $16,000.

Chilliwack, B. C.
General contract for highway construction costing $55,000 for Prov. Gov't., is awarded to Columbia Bitulithic Co. Ltd., 716 Board of Trade Bldg., Vancouver.

Madawaska, N. B.
General contract for construction of concrete arch culvert and road embankment costing $15,000 for Prov. Gov't., is awarded to Dexter & Richards, Fredericton, N. B.

Mount Albion, Ont.
General contract for construction of road costing $25,383 for Suburb Area Cmsn., Court House, Hamilton, is awarded to King Engineering & Construction Co. Ltd., Oakville, Ont.

Montreal, Que.
City Council awarded contract for sewer costing $11,200 on St. Urbain St. to C. Frascarelli, 717 Sherbrooke St. W.

Port Dalhousie, Ont.
General contract for construction of sewers costing $19,000 for Town is awarded to Peter Lorenzo, 7th St., Niagara Falls, Ont. B. F. Lamson, Engr., St. Catharines.

Rogersville, N. B.
Hanson & Gammon, Fredericton, N. B., have general contract for construction of concrete arch culvert and road embankment for Prov. Gov't.

St. Fidele, Que.
General contract for roadwork costing $10,000 for Town is placed with P. Brundage, St. Fidele.

Stratford, Ont.
Contract at $50,000 for asphalt pavement for City is awarded to Curran & Brigg, 51 Rusholme Park Cres., Toronto. Contract for curbs, gutters and concrete base is placed with Malcolm Paving Co., Stratford. A. B. Manson, Engr.

Sydney, N. S.
A. E. Cunningham, 96 Rockdale Ave., has general contract for opening Brookland St. from George St., to Union St. R. McKinnon, Engr.

Windsor, N. S.
General contract for construction of pavements for Town Council is awarded to Gorman & Peckham, Roy Bldg., Halifax.

Woodstock, Ont.
W. J. Wilks is awarded general contract for construction of sidewalks, curbs and gutters for City.

Railroads, Bridges and Wharves

Eramosa Twp., Ont.
J. J. Aldous, Rockwood, clerk Twp. Council, has plans and will receive tenders until June 26th for construction of concrete bridges. Plans also with A. W. Connor, Engr., 34 Victoria St., Toronto.

Halifax, N. S.
Nova Scotia Tram & Power Co., Barrington St., contemplate concrete block pavement for tracks on Cunard St., Agricola St. and Coburg Rd.

Orangeville, Ont.
Wheelock & Christie, Engrs., Orangeville, have plans and will receive tenders until June 26th for construction of bridges and culverts for Dufferin County Council.

St. Alexis, Que.
R. C. Desrochers, secy. Pub. Works Dep't., Dom. Gov't., Ottawa, will receive tenders until July 4th for repairs to wharf. Plans with Dep't., and at offices of Dist. Engrs., Post Office. Bldg., Quebec, Shaughnessy Bldg., Montreal, and Post Office at Grand Baie. Accepted cheque for 10% of tender required.

St. Felicien, Que.
Bridge costing $15,000 is being constructed by Town, work by day labor. J. H. Dumas, secy.

Three Rivers, Que.
City Council contemplate rebuilding bridge over St. Maurice River at cost of $400,000. Chs. Gelinas, Engr.

Three Rivers Traction Co. Ltd., St. Maurice St., contemplates street rly. extension to cost $75,000 on Blvd. Normand, Bellefeuille and St. Phillippe Sts. J. A. Ryan, Engr.

CONTRACTS AWARDED

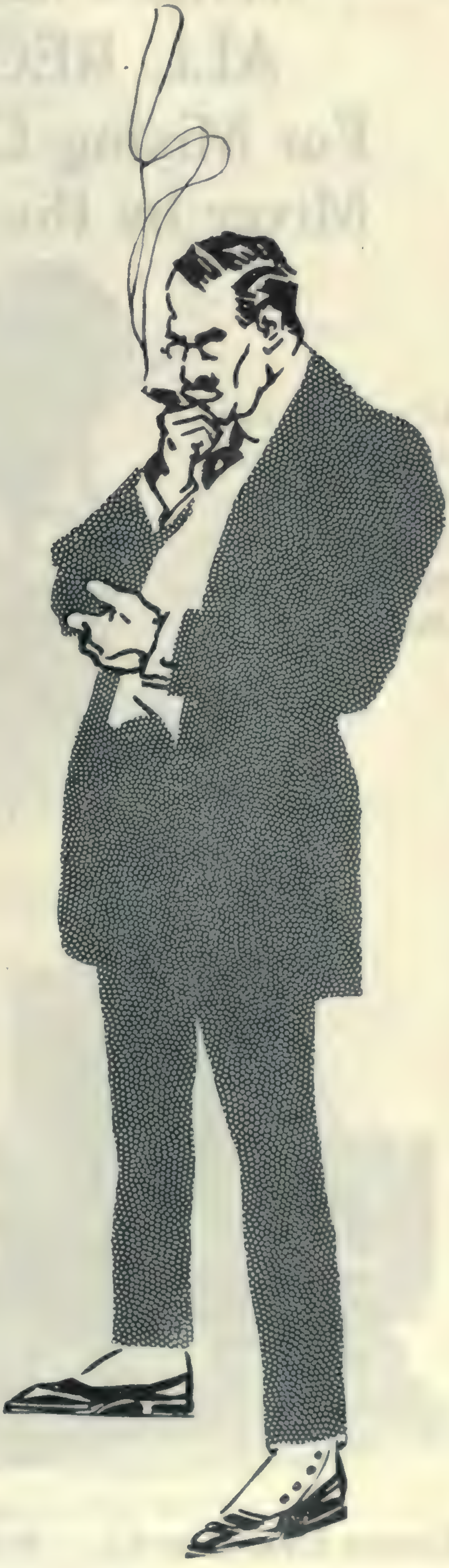
St. Malachie, Que.
General contract for construction of steel bridge costing $40,000 for Town is awarded to Jolicoeur & Veilleux, Beauceville, Co. Beauce.

Public Buildings, Churches and Schools

Bridgeburg, Ont.
St. Pauls Anglican Church Congregation will erect a parish hall.

Bruce Mines, Ont.
R. M. Rogers, secy. School Bd. S.S.

Consider This—



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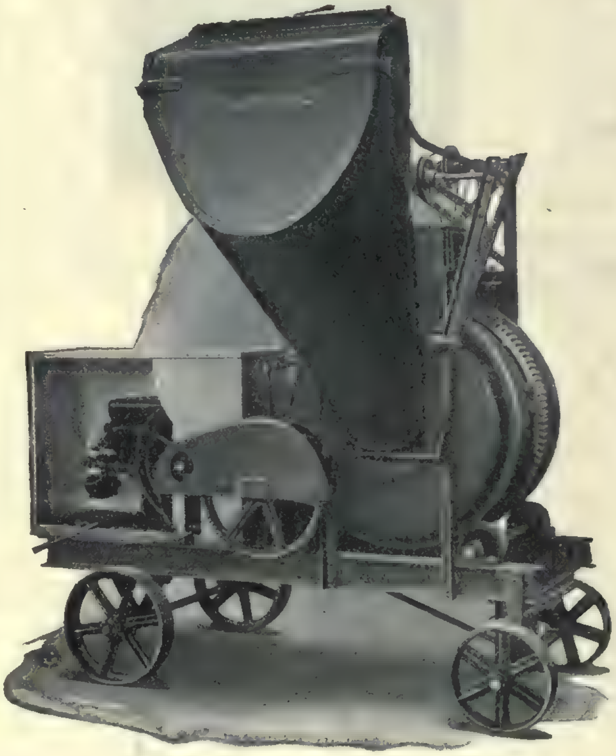
This is the machine that did it—look it over and then write for the price which is so low that every contractor or concrete worker can have one.



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Drawn by O. Cunningham

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The final test to which "Pudlo" Brand Powder has been subjected was the microscopic test, made upon some slabs of waterproofed cement concrete. The slabs were made by Mr. Johnson, of Cork University, and after an examination of the micro-sections, Mr. Johnson found confirmation of his idea that the reason for the slightly greater strength of concrete when "Pudlo" Brand Powder has been added is "due to the lubricating effect of the compound, which helps the particles of aggregate to arrange themselves more easily, thereby producing a more dense and therefore stronger concrete."

As this is the final test we would like to add that laboratory tests of any material should not be allowed to usurp the more important test of usage under practical conditions. When, as is the case with "Pudlo" Brand Powder, the consistently successful results obtained in work are confirmed by numerous scientific tests, the utility of this remarkable powder is established beyond doubt.

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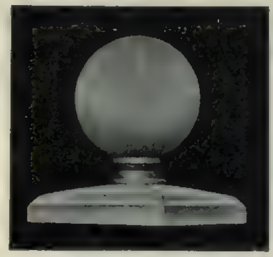

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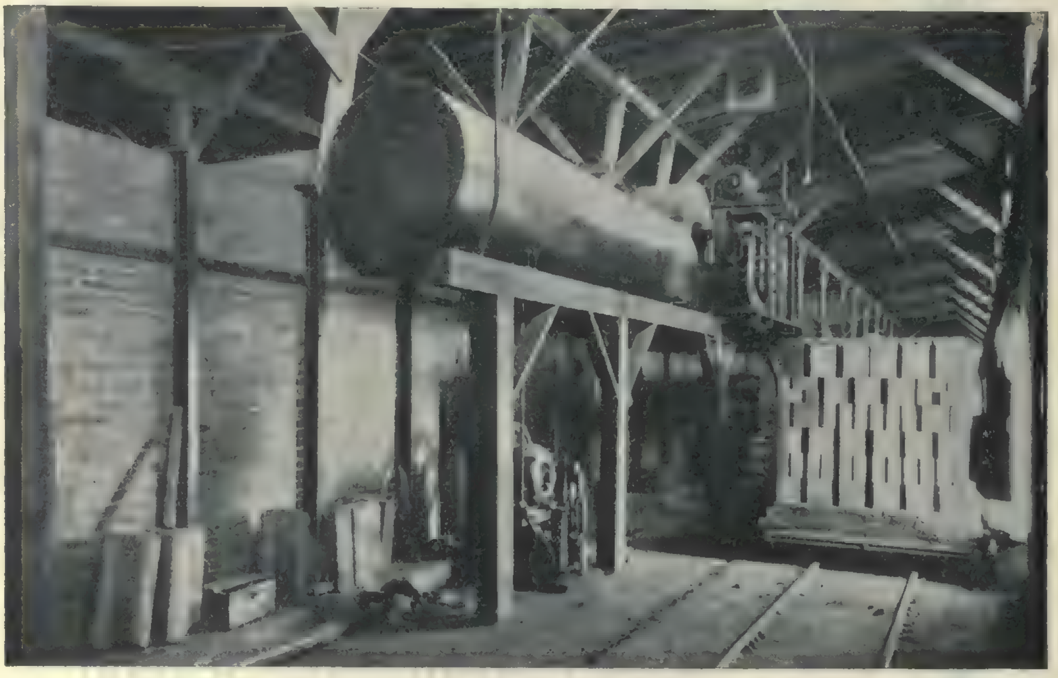

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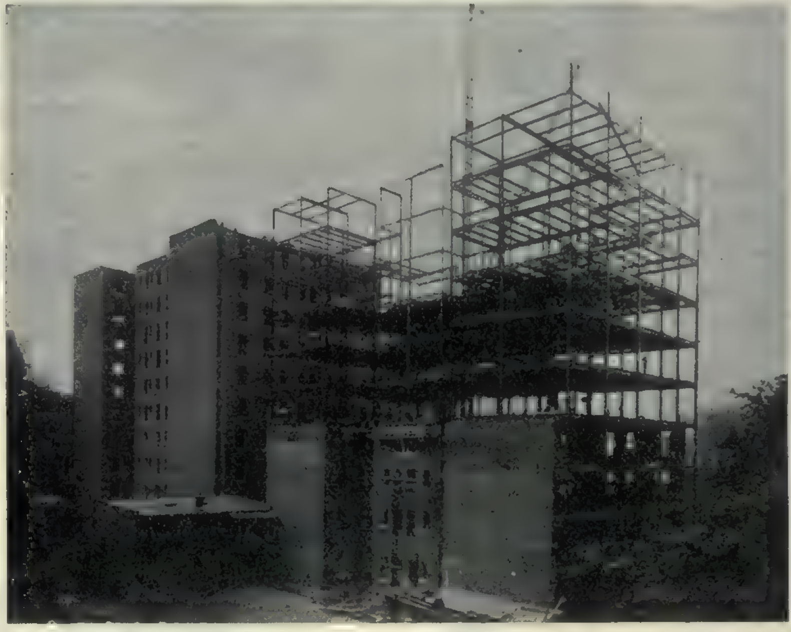

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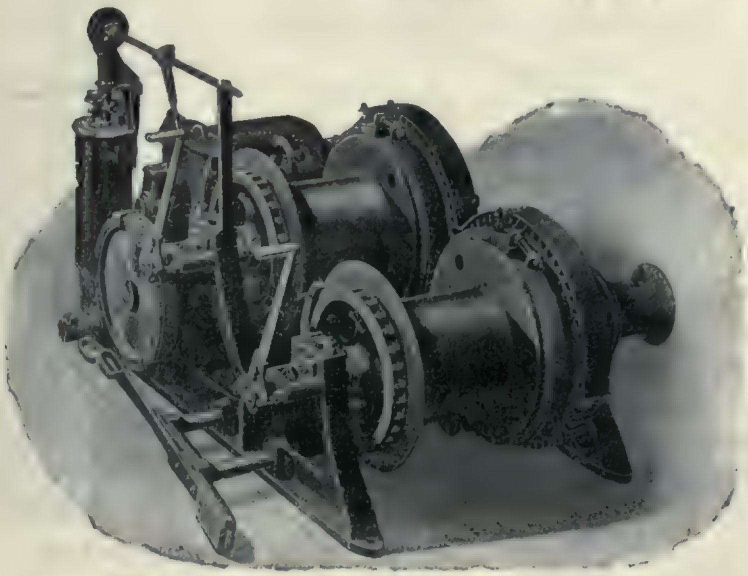

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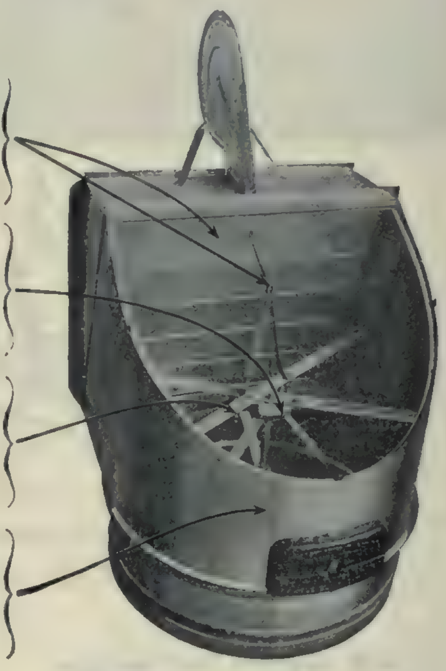

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Vol. 36 Toronto, June 28, 1922 No. 26

The Mount Royal Hotel

The Mount Royal Hotel, of which a comprehensive and authoritative description is published in this issue, is one of the outstanding construction projects on the continent. As the largest and most expensive building under construction in Canada today, it commands the attention of the whole contracting industry and allied interests. The volume of building construction, as far as the larger structures are concerned, is not very great and for this reason the Mount Royal hotel towers over anything else that is being built in this country at the present time. Even were construction proceeding with boom time activity buildings of this type would be sufficiently rare to make specific study of the Mount Royal hotel design and building methods justifiable. As a monumental structure of commanding proportions, it deserves such a comprehensive description as we have seen fit to give it in this issue. To the architects, general contractors, trade contractors, supply men and others, who facilitated the compilation of this article, we express our appreciation. We can assure them that our readers will be unusually interested in the result.

The Good Roads Convention

From a general standpoint the most important addresses presented at the convention of the Canadian Good Roads Association this year were those of the business men and the men in important political offices rather than the papers on technical subjects presented by engineers. This does not by any means minimize the value of the latter, many exceedingly valuable contributions to the engineering literature on the subject of road building having been contributed by men whose long experience in this speciality makes them authorities in their field.

It is to gatherings like these, however, that the engineer looks for his cue and obtains a clear idea of what is wanted by the public, for the class of delegates to which we refer here are men whose training has been that of keeping an ear to the ground and following the demands of the mass of the people. It is because of this that they are public men, and for the same reason their expressed wishes are to the engineer a very fair indication of what will be expected and required of him in the design, construction and maintenance of public works.

Much emphasis was placed upon the necessity of adequate drainage of road foundations, and upon the provision in all road construction of a substructure which will not require replacement when a higher type of surfacing is called for by the increasing density and weight of traffic. On the same principle, adequate planning in advance of requirements was urged, with the establishment of grades and alignments which would not in the course of a few years require drastic revision. The use of the materials along the right of way for construction purposes was urged in the interests of economy, and research to this end by the universities and the Dominion Bureau of Standards should, in the opinion of the delegates, be actively engaged in.

These are all objects with which the road engineers and builders of the country will heartily sympathize, in spite of a slight tendency which was apparent at the convention to indulge in good humored controversy regarding the respective merits of certain types of hard surface pavement. These expensive pavements fill a very important niche in our schemes of highway transportation, and their importance will increase with the development of the motor truck freight traffic now becoming so popular because of its convenience, cheapness and speed. But it will be many years before they can cover more than a very small percentage of the mileage of our roads and in the meantime, if the principles of proper drainage and of sound construction of the lower type roads are adhered to with care and foresight, many of the troubles which the future might bring as traffic increases will be smoothed over in advance.

Alberta's Road Problem

An uncommonly interesting and quite unique problem in road building that is being dealt with by the Industrial Research Department of the University of Alberta is described in a paper by Prof. K. A. Clark read at the good roads convention in Victoria and reproduced in this issue. The paper deals with the attempt which is being made to so treat the clay soil which in many parts of the province is the only material available for road building as to make it a more generally satisfactory material at all seasons of the year.

This clay is from the road maker's standpoint a peculiarly bad clay. It becomes slimy and sticky under rain, and in wet weather soon becomes impassable for vehicles. The means being investigated for relief of this situation will if successful accomplish a second object, in finding a commercial use for the immense area of bituminous sands which are contained in the northern part of the province. The paper speaks for itself, but a most interesting feature of the question was brought out in the discussion following the reading, when Dr. Clark, in reply to a question, explained that after mixture of the clay samples with the proper proportion of bitumen the resultant was not an asphalt mixture in the ordinary sense of the term. The bitumen does not form a binder; in fact, it seems to lose its identity to some extent, the result being simply that the clay loses its plasticity on account of the presence of a film or covering of bitumen over each particle. The voids are not filled, the material is not cemented, but its character is changed.

The investigation has not proceeded far enough as yet to admit of definite statements, but the result of the experiments so far is distinctly promising. Much will depend on the devising of suitable means for producing the bitumen from the tar sands, which have an 85% sand content, on a commercial basis, and on the other hand, discovering a satisfactory process for properly impregnating the road material for use. Further progress in this investigation will be watched with very great interest by road builders and the engineering profession as a whole.

"The Human Element Supreme"

A significant note was struck by the Hon. S. J. Latta in his presidential address to the Canadian Goods Roads Association at its ninth annual convention, which has just been held at Victoria, B. C. The address is reproduced almost in full, elsewhere in this issue and is remarkable for its recognition of what after all is a basic truth, but which has in the past often been covered up under a mass of facts, figures, and too often, fancies regarding the indubitably great natural resources of the Dominion.

After recounting something of the great material wealth latent in the country, he goes on to say that "the human element is Canada's greatest asset, as it is of any country" and that therefore any scheme of development must be framed primarily to advance the economic prosperity, contentment and happiness of the people as a whole.

This surely means that the time has come when it is beginning to be realized that "natural resources" in themselves are valueless apart from the hands that take them from the soil or the forest, or from the keen brains that find new methods of making the products of the country available in ever more varied forms to a larger circle of consumers. Even then they are still without practical value until the circle of industry and community life is so rounded out that the purchasing power of the people is great enough to enable them to take advantage of the country's products. For in this highly complex industrial age it is no longer practicable for most of us to take our entire livelihood from the soil and the forest with our own hands. Occupations are highly specialized and the consequent interdependence so great that only a very broad and farsighted applicaion of the truth mentioned can bring the best type of prosperity, or hold it when obtained.

The recognition of this basic truth by men in high official position marks a milestone, it seems to us, in the economic history of Canada. The years preceding the war saw us climbing into a boom which concentrated attention on speculative values. The war saw us concentrate, necessarily it is true, on a campaign of destruction, which, however, will not be all loss if it has taught the value and possibilities of team work. The last few years have been a time of taking stock, and if we emerge from them with a truer sense of values, as utterances of this kind go to prove, there is no doubt that we shall be able to make better use of real prosperity when it does arrive, and stand at least more worthy of the heritage we have in our great Dominion.

Using the Materials at Hand

More than one speaker at the convention of the Canadian Good Roads Association this year has given emphasis to the principle of making use of the materials at hand in the construction of roads. That this expression should have come from men in executive positions rather than from the engineers has a significance not to be ignored by the engineering profession, and points to the necessity of further research along the line of developing satisfactory types of road construction making use of the varying materials to be had practically "on the ground." Splendid work of this nature is being done by the engineers and chemists of the province of Alberta, and it is probable that a special type will be evolved in that province which will not only provide an entirely efficient solution of the rural road problem, as there experienced, but will also make use of a material for which an economical outlet has not as yet been found, and which is present in the province in enormous quantities.

Hard surface roads, either of concrete or of one of the several types of asphalt construction, are, of course, ideal from most points of view, but they are expensive to build and it is not at all likely that any province will find it possible to use such types except on trunk roads. By far the greater mileage will necessarily be of a lower type, and as the motor has become such a factor in the life not only of the cities, but of the rural population as well, it is squarely up to the engineers to design and build roads at a figure within the bounds of economy which will yet give efficient service under the changed conditions of the present.

Unskilled Labor

The term "unskilled labor" is very often loosely applied. It has been shown that even in the shovelling of coal, by selection of the correct type of shovel and training in proper methods, greatly increased efficiency can be secured that it pays to train common labor in correct methods.

The Good Roads Movement Makes Progress at Victoria Convention

Dominion-Wide Representation of Highway Enthusiasts at the Meeting of the Canadian Good Roads Association in Victoria on June 12-16—Unity of Viewpoint is Growing up Between all Parts of the Country—The High Spots of the Convention Reported by the Contract Record's Correspondent

The ninth annual convention of the Canadian Good Roads Association was called to order on the 12th of June in the ball room of the Empress Hotel, Victoria, B. C., with a splendid attendance from all parts of the Dominion. The president, the Hon. S. J. Latta, minister of education and former minister of highways, province of Saskatchewan, in opening the proceedings called upon a number of prominent men representing all parts of Canada to outline the problems involved in the good roads movement. Some very interesting pronouncements were made which showed a remarkable unity of viewpoint growing up between the far separated portions of this great country. These addresses, some of which were in the nature of a welcome to the delegates on their arrival in the province of British Columbia, were replied to by S. L. Squires, chairman of the executive committee in a very able and lucid statement of the aims and objects of the good roads movement.

Extending the welcome of the province to the delegates, the premier, Hon. John Oliver, made mention of the immense variety of conditions which have to be faced by those who are working for the improvement of the Dominion's highway transportation facilities. He spoke of the topographical and climatic contrasts existing between the various portions of the Dominion, and of the importance of an extensive and well maintained system of roads to the business and the social life of the community. Well considered and scientific location in the first instance is a matter of prime importance, and he instanced many roads in British Columbia which from time to time had been necessarily abandoned on account of faulty location. Concluding, he mentioned the necessity of developing types of roads, which while suitable to the needs of the traffic and the density of settlement in the rural districts, were yet within the financial possibilities of a scattered population.

The Problems of the West

Hon. Alex Ross, minister of public works, province of Alberta, spoke of the mistaken land settlement policy which had resulted in the establishment of scattered settlements far removed from each other and from modern facilities of all kinds. It is essential to give these people services of some kind, roads, bridges, and the telegraph and telephone especially, and the result has been a very heavy financial burden upon a relatively small population, and a large mileage of road to be maintained on very limited resources.

The great natural difficulties under which the western provinces labor should have more consideration by the federal government, stated T. J. Mahony, past president of the Ontario Good Roads Association. The residents of British Columbia especially, he said, are doing a great national work in opening up a country of tremendous resources, the extent of which the speaker had not been able to realize before actually seeing for himself on this trip the character of the country comprised in the far western province.

The Hon. J. L. Perron, minister of highways, province of Quebec, spoke at some length and described his impressions of the western provinces on this his first trip to the Pacific Coast. The action of the executive in planning for the convention at Victoria he held to be a wise one and in the interests of developing a closer acquaintance of the East with the West. He stated it as his opinion that the western part of Canada, in view of the opening of the markets of the Orient, has before it an even greater future than the East, having as well enormous advantages of climate, shipping facilities and raw materials of all kinds. The fact that the ports of this coast are open the year round and that a hard winter, as known in the east, is never experienced, impressed him very particularly.

Crystallizes National Thought

S. L. Squires, in acknowledging on behalf of the executive the expressions of good will to the Association voiced by the preceding speakers, briefly recounted the objects for which the Good Roads Association stands. It is non-commercial, and so can well be an efficient clearing house of public sentiment and represent the best of the national thought on the subject in a crystallized form. It represents, too, the right of the people to expect protection for the enormous investment of $600,000,000 which has been placed in the highways of the Dominion, and to see that future sums for these purposes should be laid out to the best advantage without heavy losses on unprofitable experiments.

"No province," he said, "should build roads in excess of its ability to maintain its system in proper condition for use, and the strictest economy should be inculcated, not only in the actual road-building organizations, but in the individuals of the community, in whom a sort of national conscience should be cultivated, as too often works owned by a government authority are looked upon by individuals in an impersonal way, without any sense of personal responsibility for the exercise of ordinary care over what is really community property, and as such entitled to the personal interest which goes with a sense of ownership."

Mr. Squires also mentioned the splendid work being done on behalf of better roads by the state of

California, and especially dwelt upon a comparatively recent expenditure of $500,000 in that state on a circular experimental road on which sections of pavements and road surfaces of all kinds could be given thorough tests under actual service conditions and their relative merits compared. Speaking to the engineers in the company, he went on to plead for a fuller devotion to the study of the many and intricate problems involved in the provision of highways suitable to the many and various conditions found in the different provinces, and stated that this might well be a life work for the best technical ability of the country.

The question of finance, of who should pay for the roads, is one of the searching questions of the day, and the association stands for the general principle that all the interests benefiting should bear their due share of the cost. Undoubtedly the federal government has some interest and should bear a proportion of the cost and each subsidiary authority in turn benefits and should contribute pro rata. Individuals also benefit by the increase of land values, and this unearned increment should certainly be made to take its share by the payment of a direct tax on an assessment of the increased value.

"The work of the association is nation wide, and does not recognize provincial, or even international boundaries. It believes that a better understanding will arise not only between sections of our own country, but also between Canada and our neighbor to the south as a better system of highway communication is built up and freer intercourse established."

The Human Element of Canada's Assets in Relation to Road Development

The Address of the Retiring President of the Canadian Good Roads Association Emphasizes the Importance of Keeping Human Welfare in View—The Magnitude of the Road Transportation Problem

By HON. S. J. LATTA

Minister of Education, Saskatchewan, and Honorary President, Canadian Good Roads Association

In the few remarks that I shall make from the chair on this occasion I propose to deal merely with one phase of the road problem—a phase which, it seems to me, will be even more stressed than ever as development takes place. I refer to the human element of Canada's assets in relation to road development.

There cannot be the maximum of human development without economic prosperity, contentment and happiness. These three conditions are absolutely necessary in the development of any nation and only to the extent that these obtain will a vigorous all round progress of all the people result. To bring these conditions to one class of our citizens even though that class be in the great majority is not sufficient. The principle of equal right to life and equality of opportunity must be applied to all classes even though many of these may be in a very small minority.

Hon. S. J. Latta, whose presidential address to the Canadian Good Roads Association is printed herewith.

It is well at the outset to regard two things as self-evident; first, that the greatest good comes to the individual when the greatest good comes to the people as a whole, and second, that the aggregate judgment of what is good must be the judgment to prevail for the time being. It is from this point of view at any rate that I desire to view the whole problem of transportation. The urban and rural must be considered side by side believing that each may make its just demand upon the state and that each has the inherent right to just and equitable consideration, believing that all localities are necessary and valuable as units of the whole Dominion.

Human Element Supreme

Canada is a land of enormous material wealth—a wealth that has never been and can never be accurately estimated. In many respects her forests, her mines, her fisheries, her fertile fields and her industrial centres in a comparative sense, surpass those of any country in the great wide world, yet all or any of these may be counted as an asset only in so far as they may be utilized in the production of prosperity, contentment and happiness among the Canadian people. The human element is Canada's greatest asset as it is of any country and its interest must therefore at all times and under all conditions be kept in the forefront in any scheme of development, whether such scheme touches production, industry or the accumulation of wealth of any kind.

The Magnitude of the Problem

A reference to my own province may be permitted to further illustrate the point. Over there may be found a great country within itself and it is but a small portion of the Dominion. There may be found great forests, enormous coal fields, vast fresh water lakes teeming with fish, rich mineral deposits, enormous stretches of open fertile fields and other material assets capable of bringing prosperity, contentment and happiness to millions of people. The population is less than a million, yet this small population, polyglot as it is, is of infinitely greater importance, is an infinitely greater asset to the Dominion of Canada than all the material wealth within its borders.

The problem of turning these material assets, a large proportion of which are now dormant, so to speak, into something useful to the people is the great problem of the present. In the doing of this the building of roads is a matter second probably to no other work and one that presents a mass of difficulties which are typical of all the other provinces, hence a mention of these seems to be appropriate here.

Over in that great province there are 210,000 miles of road allowances, a strip sufficiently long to encircle the globe eight times and have a few miles left over at that. On the principle that 80% of the traffic passes over approximately 20% of the road mileage, there are in Saskatchewan's system over 30,000 miles of main market roads, here again sufficient to go round the globe once and back again to the old land.

The population of a little less than 800,000 is spread over an immense area. In 1911 the density of population was 1.95 people to a square mile.

The arable land area of the three prairie provinces is estimated at 371 million acres. Over 121 million acres have been disposed of including 60 million for homesteads and 38 million of Hudson's Bay Co. land.

About 17% only of the land disposed of is under cultivation. In these provinces within 20 miles of a railway there are over 15 million acres of excellent vacant land, over 12 million acres within 15 miles of railway connection, nearly 9 million acres within 10 miles and about 4½ million acres of fertile vacant land within 5 miles of railway facilities.

Look at the problem then from another angle. Only a bit of calculation will disclose the fact that upon a family of four people—less than the average —is shouldered the enormous responsibility of building and maintaining one mile of roadway and upon five average families the construction and maintenance of a mile of main market highway. Scattered over this immense area is a polyglot population in so far as origin is considered. Descendants are there from more than a score of nationalities from all the ends of the earth, inheriting to some extent social customs and different living ideals, but, make no mistake about it, to our institutions which have stood the test of centuries, these people are loyal to the core. The fact is mentioned merely to indicate the necessity of a road building and maintaining education so that the maximum of good may be obtained from the effort put forth and the capital expended.

Typical Road Difficulties

So much then for the magnitude of the problem of building highways in only one of our provinces.

What are some of the difficulties confronting those of us who are entrusted with the solution? These again are mentioned merely for the sake of emphasis, to bring the whole matter squarely before us, not only in Saskatchewan but in all the provinces, because the same difficulties obtain to a greater or less degree in every province of Canada.

Road material in many localities is scarce and therefore the expense of transportation is so great as to compel the use of the earth close at hand. How best therefore to build a serviceable earth road must be faced and the problem must be solved. This alone is a matter calling for the most expert engineering knowledge so that the foundation laid may not represent wasted capital but capital expended in laying the foundation of a road bed that will be useful when the population and traffic demand a type of highway of higher quality.

The shortness of the season, the difficulty of drainage, the scarcity of labor and other things must also be considered and the best means of solving these difficulties must be sought and found.

Generally speaking there has been no proper planning of rural or urban areas. The survey merely adhered to the rectangular system according to certain principles laid down by land surveyors. There seemed to be the necessity only of mapping out territory on a geometric plan with little regard to physical features, giving heed rather to accuracy and simplicity in defining unit boundaries The economic use of land in a general way seems to have been regarded at least incidental rather than essential. This system tended to the marking out of too many miles of road because there are more miles of road than, on the most liberal estimate, the taxpayer is able to construct properly.

The rural percentage of population in Saskatchewan fell from 80.7 in 1901 to 73.3 in 1911 and further to 73 in 1914. In Manitoba it dropped during the same period from 72.4 to 44, in Alberta from 71.8 to 60 and in British Columbia from 49.5 to 44.6. In Ontario there was also a decrease of 4%. These figures relative to the rural population are quoted not with any desire to depreciate the value of the urban but rather to provide material for consideration in the development of an all round and well balanced population. Canada is still a nation with an enormous majority of rural population. May it be that these figures indicate a greater necessity than ever for greater attention to the highway problem as it touches the interest of those who are entrusted with the production of our vast raw materials.

Conservation and Development

To me at least these things indicate that the period of pioneer achievement is still with us. Conservation and development is Canada's great present need. Her problems are old but her viewpoint must be new. She must enter upon a new phase in the light of the experience of the past.

The new viewpoint will accentuate the principle that wealth is produced not from the mere existence of great material resources but in the most economical conversion of these into something useful to promote comfort and happiness among the Canadian people. It is true that Canada's progress is seriously limited by the extent to which it lacks the human asset sufficient to develop and distribute her natural resources. The vital problem therefore is how best to increase this human element of her assets and how best to conserve and develop that which she already has.

Sometimes one is inclined to believe that Canada has committed the error of regarding the increase of population as the essential thing, that the quality of population is of minor importance. If by increasing our population we are able to secure greater prosperity per capita then steps ought to be immediately taken to do so. If on the other hand an increase is such as to lower the per capita prosperity then we should strive against it. History is full of examples to show that the population of a country of great resource may grow and still the prosperity of its people may diminish.

The great thing is to strive to promote healthy and pleasant living conditions, to make the best possible economic use of land and other natural resources, to utilize science and expert knowledge that the greatest productive and industrial efficiency may be secured, and, in all of these activities to keep constantly to the fore the progress, contentment and happiness of all our people, rural and urban.

While it is freely conceded that no nation can be greater than its Christian ideal, that no citizenship can be more intelligent or virtuous than the quality and extent of its educational institutions, there are other material things woven and interwoven into the warp and woof of the nation's activities that bear a very important relation to and play a very important part in the conservation and development of progress, contentment and happiness.

To-day this great convention is called to consider one of the greatest of these things—one phase at least of one of the greatest of these things, the problem of transportation. Experts are here from all over Canada and from outside of Canada. Here you have come to exchange experiences, to discuss viewpoints, to recommend the best considered schemes for conservation, development, and improvement, to discuss how best to surmount the difficulties that are found, how best to choose, build and maintain the classes of highway that may serve all to the best advantage and carry over the systems the transportation that presents itself with the maximum of efficiency at the least possible expense to the taxpayer.

Human Asset Supreme

This ideal must be kept ever before you, that national prosperity is built upon character stability, freedom, efficiency, and happiness of the human element of our asset, rather than upon the money value of our national resources, our exports and imports or the gold that may be stored safely in the public chest.

This then, in a general way is the objective to be kept always to the front.

In the carrying out of this great work of providing means of transportation, may I venture a few suggestions that may assist the Association in performing the functions for which it came into being—a few matters that ought to be kept constantly in view in the discussion of detail in road location, road construction and road maintenance.

Railway Transportation

The development and location of our railway systems have had a very material effect upon the location of our population and the development of our natural resources. No particular blame is attached to any one because of the failure of this work to accomplish the maximum of good. Had the present generation been entrusted with the task of those of earlier days without the experience of the past the work would not have been done any better, but because those of the present have the experience of the past, many of the mistakes of earlier days must be avoided. In future, railway systems, if the maximum of good is to result, must be scientifically planned, duplication must be avoided, and location must be attended to that localities fit for development may be populated. In short, the wise railway policy of the future, both in the interest of the settler and the railway capital invested, will be such as to make the location of the lines conform to a previously considered and scientific plan of land settlement and rural and urban development.

Before more railways are built or branch lines extended land areas must be examined and where found fit to serve the human element of our assets, scientifically planned road systems ought to be devised so that the various elements—railways, roads, economic value of land—may be made to fit in with each other in the interest of all the people. Railway development must be directed primarily for the purpose of securing the profitable development of our natural resources in the interest of the people rather than to provide profit upon capital invested in railway enterprise.

Value of Roads as Feeders to Railways

Because of the lack of good roads and improper land settlement, the cost of the transportation of produce to railway points is often far in excess of the cost of railway transportation. It is asserted also by those who have given the matter consideration that the railway traffic at country points falls off in many cases to as much as 50% during seasons when the roads are as a consequence, unfit for travel. The absence of proper road communication is probably the most serious handicap both to those who have money invested in railway industry and to those who live upon the land. In fact no railway system can serve the people for whom it is constructed to the maximum of efficiency unless co-related with it there is developed and maintained a system of good roads.

Location of the System

The location and difficulties mentioned as obtaining in Saskatchewan obtain to a greater or less degree in every province in Canada, and principles that apply there apply in like manner as the demand necessitates all over the Dominion.

Human necessity and traffic requirement should be the guiding principle in the selection and location of a system of highways rather than the adherence to an artificial system of straight lines. To this end the following details ought to be considered:

1. The greatest good to the greatest number.
2. The most direct route possible for the traffic requirements.
3. The avoiding of sharp and dangerous curves.
4. The advantage of easy grades.
5. The minimum cost of construction.
6. Economy in cost maintenance.
7. The co-relation of each road selected and located to all other portions of the whole system.
8. The relation of the road as a feeder to the railway system.
9. The facility with which the road may be drained
10. The proximity of road material.
11. Requirements for the future.
12. The necessity for bridges and culverts.
13. The money available for the project proposed.

When all these things are carefully considered in the planning and location of a system in any given community and the systems of all communities are properly related to each other in a massed system for the whole country, the classification of roads according to value may be easily accomplished.

The advantage of careful and scientific planning cannot be overestimated. It may be said, however, that a well planned road system will help to build up manufacturing industry, cheapen the cost of raw material, reduce the cost of living by bringing the rural resident within closer reach of the urban dweller, will help to attract settlement and elevate the social life of the community. These and a thousand and one other benefits will result, all of which will tend to raise the economic use of property to the maximum at the minimum of human effort, thus recognizing the principle that our human asset demands and deserves our first and most serious attention.

Selection of Type

A prominent engineer was one time asked, "What kind of roads do you propose to build on your system?" The answer very properly given was "All kinds." In seeking for a principle for guidance in the selection of the type of road to build, it will be found that the same principle has been expressed in many ways. One prominent road builder has said that the main consideration should be to secure the maximum of convenience at the minimum of cost. Another expresses the principle in another way but probably it is as simple to say that the type of road to build on any part of a system is that type which will carry the traffic which will go over the road at the least possible expense, direct or indirect. In other words there must always be recognized the close relation existing between the type of road chosen and the quantity and quality of the traffic going over it. It is bad business to put $20,000 a mile into a road over which the traffic is light and equally bad business to be content with a one thousand dollar road where the traffic is very heavy. It is not intended to pursue this idea further into detail; it is sufficient to say that there are ample records kept to prove the soundness of the principle.

These observations lead one to wonder why in the laying out of our road allowances all have adhered to a standard width regardless of the locality or the traffic that may pass over it. Surely if the relation of traffic to type is so close and so important there is a lack of economy in the choice of a rigid standard width of roadway.

What has been said in a very general way is applicable also to the choice of type of culverts and bridges. There are instances of a very expensive type of bridge being the least economic type to choose for a certain location and on the other hand where it may be false economy to build a low type bridge at small cost. All kinds of bridges and culverts may be as scientifically correct as all kinds of roads.

Road Construction

During the past number of years it has been my lot to consider the highway problem in its wider aspect. Details of construction have been left to the ingenuity and efficiency of men trained in engineering and practical road building. My observations, however, have caused me to arrive at certain general conclusions regarding the construction of roads.

Drainage to me is the great thing. Without proper drainage a road otherwise well constructed cannot serve its purpose to the maximum. If it were practicable to smooth down a stretch of roadway, then build a tent over it, so that it might be always dry, ninety per cent. of traffic trouble would in ninety per cent. of cases disappear. Drainage in the matter of construction is of paramount importance and the greatest ingenuity of the best engineering skill ought to be directed to this end. Whether the type be of a low grade earth road or of the highest type of hard surface, road drainage is equally important. The expense saved in the neglect of proper drainage is money wasted in the matter of construction. Just as much engineering skill of its kind is demanded in the proper construction of a low type road as in that of a high type road.

Herein is laid the foundation for a road of higher type as soon as the population and traffic demand it If the foundation be not well laid then the capital expended has been expended in vain. Sometimes it may be impossible to do so but in every single case where at all possible every single dollar spent ought to be so spent as to be useful as soon as the surfacing for a higher type is demanded. A properly located, well built and efficiently drained earth grade when amply consolidated by time, traffic and maintenance ought to be a good foundation for at least a finished gravel or macadam road as soon as the traffic requirement demands it.

Maintenance

One of the greatest problems of the present is that of proper road maintenance. It is simply appalling to consider the enormous sum of money in the aggregate already invested in Canada's road plant and at the same time to view the neglect in the aggregate of effort to preserve the capital thus invested. Here again the matter is of equal importance whether the road is of high or low type. I do not believe as some have stated that the money spent in the maintenance of the much maligned earth road is money wasted. The money not spent in the maintenance of the low type earth grade is the money really wasted. Just as it is economical on some parts of a system to choose an earth grade to suit traffic conditions so it is true economy to keep the earth grade in good repair.

Drainage is as important in maintenance as it is in construction. Throw a glass of water over the surface of the kitchen table. Lay a clod of earth on the wet table. In a short time the clod of earth is quite damp for some considerable distance above the table surface. So it has been proven by actual examination that the sub-grade of an earth road is damp for some considerable distance higher than the surface of the water in the ditches contiguous to the grade. A damp sub-grade cannot carry as much nor as heavy traffic as one that is dry.

Select two small plots a couple of feet square in your garden. When rain comes and the earth is saturated with water, puddle and mix one of these with a hoe. Smooth down the surface and allow both to dry in the sun. After drying process has been completed notice the surface of the two plots. The puddled plot is hard and firm. So it is with the road drag on the surface of the earth grade. The puddling process of the traffic and the drag together with the baking process of the sun and wind will make the surface so hard that a roof has really been constructed over the grade. The drag will make the surface of that roof smooth for traffic and in addition make it possible for the water to run off into the ditches instead of re-saturating the road.

There are of course different qualities of earth. Some lend themselves to a better grade in this respect than others. My own experience has brought me into actual observation of a road of suitable earth material of such a quality that when examined after quite a considerable rain was found to be quite dry and hard two inches below the surface.

The road drag, although a quite old instrument for use in earth and gravel road maintenance, is still efficient and economical when properly constructed and properly used at the proper time.

Organization for road maintenance all over Canada is only in the pioneer stage and an exchange of experiences along these lines ought to be profitable indeed. It is a subject, on the whole, fit and proper to engage the attention of all organized bodies having to do with highway construction all over Canada.

Financing Roads

Next to education, the financing of highway construction is probably the largest problem with which the Canadian taxpayer has to deal. The enormous expense, direct and indirect, of trasportation, railway and road, calls for the consideration of the best brains in finance and construction that Canada is able to produce.

The problem of finance bears a close relation to every phase of the transportation problem. In the location of a system care must be taken to select mileage capable of being financed by the taxpayers concerned. Rightly or wrongly the mileage must be such, the expense of which the taxpayer is able to bear. In the choice of type too, the same principle must apply. An eminent engineer has estimated the cost of haulage over the various types from 35 cents, the pro rata cost of one ton a distance of one mile over a level dry sand road, to 10 cents over a level asphalt road. At the same time the taxpayer must be satisfied with that type of road within the bounds of his financial ability.

All over the continent of America, in every state of the Union, and in every province of Canada, governments, federal, provincial and municipal are appropriating millions for the construction of roads, a fact that accentuates more than ever the necessity of attention to this element of the problem. Great care must be exercised that millions are not wasted, as every dollar is needed and every dollar ought to be put to the best possible use.

Government Aid

In the matter of Dominion aid or provincial aid, it seems to me that certain principles ought to govern the distribution of funds. Road building is a great co-operative enterprise. The taxpayers of any given community—a municipality if you will—co-operate with each other in the interest of all. Two elements enter into the method of the distribution of funds to carry on the co-operative enterprise, first, ability to contribute, and second, the benefit derived from the utility provided. If this principle be sound, then provincial aid to the communities within the province ought to be given on the same basis. It is quite evident that a basis of population may not fulfil all the requirements of the purpose of co-operation. In like manner it may easily be shown that the distribution of federal aid by the Dominion Government among the provinces on the basis of population may be unjust and inequitable.

Responsibility of the Association

It must not be concluded that because the Canadian Good Roads Association is made up of a voluntary membership that its responsibility, in a moral sense, is in any way lessened. Notwithstanding the fact of its voluntary nature, it wields an influence second to no other organization having to do with highway transportation and construction.

In this brief address there has been an attempt to do but one thing, namely to emphasize what may be termed for the want of a better name, the human element in the road building problem; to emphasize the fact that the possession of great material wealth of natural resources will of itself alone never bring greatness to a nation. To conserve and develop these, that economic progress, contentment and happiness may come to the human element of Canada's assets is the greatest thing after all. Whatever reference, in a necessarily brief way, has been made to location of a system of highways, to the choice of type, to construction, to maintenance and to finance, has been for the purpose of indicating that sound principles ought to govern everp step in development and that in every step human interest ought to be of the premier consideration. Every act, every conclusion, every recommendation of the Canadian Good Roads Association will carry enormous weight in the formation of public opinion upon this great topic, and, as its membership stretches from ocean to ocean, its viewpoint will be sufficiently broad to consider all phases, all interests of all localities of this great country, to the end that no east, no west, no centre, but a united people hold firm in the belief that the greatest good comes to each unit when the greatest good comes to all.

Foundations of Highways

J. A. Duchastel Emphasizes Importance of Drainage – Determination of Thickness of Base

J. A. Duchastel, manager and city engineer of Outremont, Quebec, and a past president of the Canadian Good Roads Association, presented a well considered paper on the foundations of highways, in which he emphasized particularly the necessity of efficient drainage as a first essential to permanence of roadbeds.

He described in detail the construction of the various types of road base, which he listed in order as gravel, crushed stone, V-shaped, Telford, field stone, hydraulic concrete, and the so-called "black base" or bituminous concrete.

The heaviest load for which provision need be made at present he considered to be the 15-ton tractor, which has a rear axle load of 10 tons. But special consideration must be given to the question of impact, and the volume of traffic is also a potent factor, as a base which may stand a given load applied once will often fail if the same load is frequently repeated.

The necessary thickness of base is determined by the safe bearing power of the soil and the weight of traffic with impact added. Weight is distributed through the road base to the soil at an angle of 45 degrees in all directions from the point of application, so that when the safe load on the soil has been determined it is a simple matter to calculate the necessary thickness of base course.

The principle enemies of roads everywhere are poor drainage, the action of frost, and the tendency to overload.

Bituminous Sands of Alberta as a Road Building Material

The Deliverance of the Prairies From Bad Roads May Result From Discovering How to Use the Bitumen From the Athabasca Deposits as a Soil Modifier

By Dr. K. A. CLARK
Industrial Research Department, University of Alberta

Two closely related Alberta problems are being investigated at the industrial research department of the University of Alberta, namely, methods of improving our prairie roads and methods of development of the Athabasca bituminous sands. It is not obvious, at first sight, that these problems are related. Yet, it seems probable that it is to the deposits of Athabasca bituminous sand that the prairie provinces should look to find the supply of road material that will act as a substitute for the stone and gravel materials used in the making of the well-known hard surfaced roads, which are missing in the prairies. The bituminous sands contain an asphalt which, when separated from the associated sand and mixed with prairie soil, quite profoundly changes the nature of the soil and makes it resistant to the unstabilizing action of water. Natural prairie soils, if at all clayey, take up water with avidity and promptly turn into a sticky, unstable mud that is the despair of both the traveller and highway engineer.

The relationship between the prairie road problem and the bituminous sand is interesting. The prairie road problem is well-known; a tremendous mileage of highways; mud of the worst kind; generally speaking, no supplies of stone or gravel with which to make road surfaces; and not a large enough population or volume of traffic to warrant importation of materials to build the well-known hard surfaced roads at any cost. In connection with this road situation consider the other problem. In the north of the province of Alberta there are about 15,000 square miles of country underlain by sand impregnated by asphalt. Large quantities of this bituminous sand are in plain sight along the banks of the rivers which have cut their valleys through the formation. This bituminous sand deposit is the largest of its sort so far found anywhere in the world. It is one of the big resources of Alberta.

Difficulties in Developing Bituminous Sands

Two obstacles stand in the way of its development: first, the lack of an economical method of separating the asphalt from the sand so that 85% of sand may be left in the north and only the 15% of bitumen be shipped out; secondly, the lack of a sufficiently extensive use for the asphalt, when separated, to make feasible the establishment of development operations. The industrial research department of the University of Alberta is searching diligently for a method of separation and if present favorable indications continue favorable, it will find one. It is in regard to the second obstacle that the connection between roads and bituminous sands arises. The big use for asphalt today is in road construction. Our prairie provinces need roads. If it can be discovered that by the use of reasonably small amounts of bituminous-sand asphalt, a type of prairie road adequate to the needs of the rural communities can be built economically, then a big outlet for asphalt from a bituminous sand industry will be open. The solution of the prairie road problem and of the tar sand problem are tied up together.

The development of a type of prairie road with the aid of bituminous-sand asphalt will depend on an understanding of the properties of prairie soils. The outstanding property of prairie soils, from the road point of view, is their mud-forming ability in presence of water. What is the reason of this mud-forming ability? Studies by soil chemists and physists have assigned the reason to the colloid content of the soils. The term "colloid" need not introduce any mystery into the discussion. Everyday experience brings us all into contact with colloids. Two common examples are gelatine and glue. These substances are hard, stable substances when dry and have marked binding qualities but when placed in water they swell to unstable jellies. In many places throughout Alberta, nature has concentrated a natural colloid which, if it is not the actual colloid present in our prairie soils, must be very similar to it. I refer to "bentonite." Bentonite is a hard, almost stone-like material when dry, but in contact with water it swells to about eight times its dry volume into a sticky, unstable mass. Granted that bentonite or a similar type of substance is present in our prairie soils, it is not so hard to understand their hard, stable nature when dry and their marvelously quick change to unstable mud when they become wet. It is the presence of such a constituent in prairie soils which makes it so difficult to get a satisfactory sand-clay mixture for prairie roads. Many prairie soils are natural sand-clay mixtures, yet they soften badly when wet. The key to the situation is to find some way of modifying the soil colloid so that it will not swell in presence of water—some way of keeping it always in its stable form.

Possibility of Modifying the Soil

There is a property of colloids which offer hope of accomplishing the result of modifying the soil colloid so that it will not so readily swell in water—the property of "adsorption." The term "adsorption" is probably still more mysterious than that of "colloid." There is no mystery about it, however. Adsorption is a property which all matter, in the liquid and the solid form at least, possesses of condensing and tenaciously holding onto its surface a very thin layer of other substances with which the surfaces comes into contact. Everybody has observed the working of this property. Why does a canvas tent shed rain? Because the dry canvas has a layer of air adsorbed onto the surfaces of all its fibres and the rain must first displace this adsorbed air before it can penetrate the canvas. Why does a shower penetrate such a little way into dry sand? Because the dry sand particles have a layer of air adsorbed onto their surfaces and this air must be displaced before the sand particles can be made wet by the rain. Colloids are made up of exceedingly small particles. The result is that a small amount of colloid has a tremendous amount of surface. Since adsorption is an effect that takes place on surfaces, adsorption is a very prominent property of colloids. If a fine soil, such as a clayey soil, is shaken up with a dye solution and this mixture placed on a filter, the solution which filters through is colorless. The soil particles, especially the very fine, colloid particles, have adsorbed the dye which was dissolved in the water and have left the water colorless. There is a sort of substances that soil particles will adsorb in a similar manner to the way they adsorb the dye. If the soil particles could be brought into contact with some suitable substance—a substance, an adsorbed layer of which on the surface of the soil particles would prevent them from taking up water—then a remedy for the mud-forming propensity of soils would be in sight.

Bitumen Counteracts Water Action

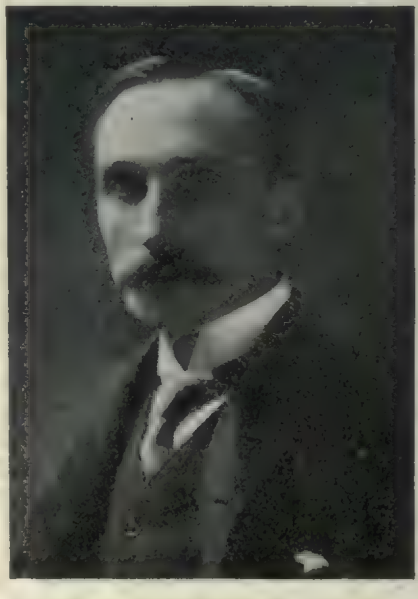
Bitumen such as asphalt, is a substance which repels water. Bitumen at once suggests itself as a substance to try to get adsorbed onto soil particles. Experiments tend to show that bitumen is adsorbed by the soil particles and that this adsorbed bituminous layer prevents the soil colloid from swelling in water. When the rather soft asphalt which is separated from the Athabasca bituminous sands is mixed with a wet soil, the asphalt readily works through the soil and is apparently distributed over the surfaces of the particles. When the wet soil into which the bitumen has been mixed dries out again, it is found that it has largely lost its ability to again take up water, at least at all readily. The quantity of bitumen that it is necessary to mix with the soil to accomplish this result varies, of course, with the clayey nature of the soil.

Experiments at the University of Alberta have been made on a series of soils including a sandy soil from the south of the province, silty soils, a natural sand-clay mix and heavy clay soils. The method of test is very simple. A sample of the soil is made sufficiently wet with water so that it can be easily worked. The desired amount of asphalt, as separated from the bituminous sands, is added and worked through the wet soil. The sample is then compacted into a small wooden box and the top rounded off to imitate a miniature section of road and set away to dry. It is then exposed to wet conditions which are created by the spray from a garden hose. Samples are placed under the spray at the close of the afternoon and the result observed the following morning. By arranging a series of samples of the same soil containing varying percentages of bitumen, the advantage gained over the natural soil by addition of the bitumen, and the quantity of bitumen which must be added to render the soil stable against the artificial rain, are at once apparent. It is found that 5% by weight of the bituminous sand asphalt is sufficient for the sandy soils, from 5% to 10% for the silty soils, while for the heavy clay soils 15% to 20% is required. The bitumen for a heavy clay soil appears to be excessive. However, in a practical application, the proper procedure would be to make a sand-clay mix and incorporate into the sand-clay aggregate 5% of the bituminous-sand asphalt. The sand for admixture would not need to be a coarse sand, as is required for ordinary sand-clay construction, for the bitumen-treated clay will be stable under wet conditions as well as under dry

The New Officers of the Canadian Good Roads Association

Hon. J. L. Perron, president

Russell T. Kelley, 1st vice-president


F. L. Fellowes, 2nd vice-president

conditions. If this scheme proves to be of practical value, the prairie road type may become, not the sand-clay type, but a modification of this type—a sand-clay-bitumen road.

The Hope of the Prairie Road Builders

The idea of using bitumen in a soil mixture especially in the way that has been described may seem novel to many but in reality it is not new. Oiling earth roads has been quite extensively practised and has met varied success. A type of pavement called the "bituminized earth pavement" was proposed a few years ago in the States. It was made by incorporating about 17% of asphalt into dry, pulverized clay soil. The Bureau of Roads' progress report for 1916 gives an account of an experimental piece of road construction very similar indeed to what we have been discussing. Hot asphalt was mixed into wet clay. The results were rather encouraging but the idea was not carried to a definite conclusion. Bitumen is also being used by the Bureau of Roads in experiments to stabilize subgrades for pavements. We do not claim any great share of originality for the work being carried on at the University of Alberta on the road problem. It is simply a case of trying to apply what has already been found out and what little else we can ourselves find out to local conditions which we have to face in our prairie provinces. Nature has not provided us with the material to build the well-known types of hard surfaced roads and we cannot afford to import these materials. Yet we need something better than the plain dirt—when the weather turns wet. If most prairie roads could be made to stay as stable when wet as they are when dry, our roads would be plenty good enough for our needs for some years to come. If we can get the asphalt out of the Athabasca deposit of bituminous sand cheaply, I believe it is possible for the prairie provinces to make economical roads that will be serviceable whether it rains or shines.

Drainage Methods for Prairie Roads

Proper Crown for Clay Roads—Handling Drifting Soil—Requirements of Economy Exercise a Severe Limitation on Drainage Undertakings

A very interesting paper was read at the second session of the Canadian Good Roads Convention by H. R. MacKenzie, chief field engineer, province of Saskatchewan, on "Drainage Methods for Prairie Roads." Taking the natural divisions of his subject, Mr. MacKenzie first dealt with the disposal of surface water, which depends first of all upon proper crowning of the roads. The amount of crowning allowable is limited by practical considerations, as many of the rural roads of the province are necessarily built of clay, which becomes very slippery and quite impassable if the crowning is excessive. The limit has been found to be ½ in. to one foot, which has given very good satisfaction. Trials of a sharper crowning have been found to lead to the development of ruts, as vehicles, especially in wet weather, were forced to keep to a single track, with the result that traffic was very soon completely at a standstill.

The longitudinal drainage is a more difficult problem, and is accentuated during the spring thaws, which in certain districts especially causes at times serious damage. It is found to be a difficult problem to properly educate the local authorities as to the best methods of drainage, the tendency being to dig deep ditches to obtain crowning material, without regard to proper gradients to allow the water to run off.

Trouble With Drifting Soil

One difficulty unknown in other parts of the country is that caused by drifting soil in the dry seasons. Blown across country by the prairie winds, this material, a fine granular clay, is impossible to handle satisfactorily until saturated by the fall rains, when it is dragged to the crown of the roads and soon consolidated by traffic. It is anticipated that it will be necessary to build fences to protect the roads from this drift, similar to the snow fences already familiar as a winter protection.

Particular attention is given to the provision of culverts, which are of three general types: viz., pipe, either galvanized iron or concrete; box, either concrete or timber; and arch, of concrete. It is sometimes necessary in river valleys, to build the roads in embankment, five or six feet above the general level of the ground. Permanent channels are then left for river flow and for the sake of economy these are usually constructed with pile bents, as the cost of concrete culverts in these cases would be prohibitive.

Little underdrainage is attempted on rural roads, save that provided by the side ditches. In a few cases, in cuts where sidehill seepage was encountered, a drain was found to be essential, and for these a ditch of suitable depth, rock-filled, is used. The average cost of the rural roads is $2,000 per mile, and while the department is fully aware of the necessity of drainage, and is always working to improve its standards, the requirements of economy exercise a severe limitation.

Subsequent discussion brought out an interesting description of the dry well system of drainage, as practiced in certain parts of Manitoba, but the lecturer stated that this had not been attempted in Saskatchewan owing to the great depth of the gumbo soils.

Build of Materials at Hand

Advocating a majority mileage of roads built of earth, rock and gravel—in other words, the materials at hand—A. P. Sandles, of Columbus, Ohio, and for seven years secretary of agriculture of that state, spoke to the delegates as the opening speaker of the fourth session. There is no such thing as a permanent road, he maintained, stating that apart from proper upkeep, the very best road it is possible to build would deteriorate. Roads should be primarily for the farmer, as the real producer of the country, and costly trunk roads designed principally for the advantage of the motorist on pleasure bent should be discouraged.

Dominion Government's Road Policy

Every Province Taking Advantage of Federal Assistance—18,000 Miles of Roads are Involved—Co-ordination Between the Provinces

The address of Mr. A. W. Campbell, chief commissioner of highways, Dominion government, was a notable exposition of the policy of the Dominion government on the good roads movement. Bearing in mind, he said, that the audience present represented hundreds of thousands of good roads enthusiasts, the people who use the roads rather than those who build them, his remarks would be confined rather to the business side of the question, than to the strictly engineering features, interesting as those are in themselves. As a business problem it is an exceedingly serious matter, and the provision of better roads means more than the mere provision of highways which would carry any certain traffic, but involves most careful and cautious planning, in view of the necessity of the greatest economy consistent with meeting the present needs of the traffic, but in such a manner that any work done will provide a basis for subsequent improvement, instead of requiring complete reconstruction when the demands upon the route become heavier.

The Federal Highways Act was passed in 1919, and provides an appropriation of $20,000,000 for use throughout Canada, not for the construction of ideal roads, but with the object of co-operating with the various provinces in the building of the various types of road found most suitable to individual localities and to the requirements of the traffic. The result has been that aid has been given to almost every class of road construction, from the earth road of the rural districts to the highest type of hard surface pavements. Enormous sums are being spent, both by the provinces and by municipalities, and wonderful strides are being made in the development of a system of adequate and well kept communications. The speaker especially commented upon the great work being done in this direction by the province of British Columbia, but said that every other province is as keenly alive to the need for this class of improvement, and it will only be a matter of a very few years before Canada has as fine a system of roads, connected from coast to coast, as can be found on any portion of the continent.

Co-ordination of Provinces' Plans

To a wonderful extent co-ordination of plans has been accomplished between the provinces, and filed with the speakers office at Ottawa is a series of plans embracing the road projects of each province under this Act, and representing a coast to coast system of roads totalling in length about 18,000 miles. This is an immense task, a tremendous investment in prospect, and calls for the very best of engineering talent of the Dominion for its proper carrying out, and for the highest type of executive ability for farsighted and economical administration.

While wonderful strides have been made towards the desired end during the last few years, the problem has been seriously complicated by the radical changes in fundamental requirements which have occurred during the same period. The old scale of road building costs called for expenditures of from $1,000 to $10,000 per mile. To-day, the scale is much higher, and roads are being built at costs of from $20,000 to $40,000 per mile, with exceptional cases which may run as high as $60,000 or $70,000 per mile, so that the appropriation under the Act is evilently none too large for the purpose, even when it is remembered that an expenditure of $50,000,000 is required of the provinces to qualify for the $20,000,000 provided by the federal government.

Every province has framed its own plan of road building, and built up its own organization for carrying this into effect, and the very cautious and sane manner in which they are going to work is considered highly creditable. So conscientiously is the work carried out that the federal department finds it unnecessary to exercise a very close supervision over the construction operations, finding that the desire and ability to procure results is universal.

Importance of Maintenance

The speaker proceeded to emphasize very strongly the need of efficient maintenance organizations for the protection of the country's great investments in roadways, and urged that separate branches should be established in the highways departments for this purpose, maintaining that engineers interested primarily in construction do not make good maintenance men. A special type of character is required for this work, patient, painstaking and fond of minute detail in supervisory work, and much future loss and expense would be obviated by having in charge of the roads when completed men of this type, whose sole interest would be to keep the roads constantly in a state of repair.

In conclusion Mr. Campbell mentioned the fact that the investment in motor cars throughout Canada such magnitude has a right to protection from the totalled $450,000,000 and said that an investment of wear and tear which bad roads cause to cars. The motorists of the Dominion have a right to good roads, to enable them to either cross the continent or travel from place to place, and the present movement is thus very much in their interest, as well as in that of the people as a whole.

Earth Roads in the Prairies

Some instructive figures dealing with the building of earth roads in the prairie provinces were given by Mr. J. D. Robertson, Deputy Minister of Public Works, Alberta. Dealing with conditions as obtaining in Alberta, he said that the extremes of type represented in their work are the open level prairie and the timbered country of the northern part of the province. Generally speaking, from 9 to 11 miles of grader travel is required in forming one mile of road. The last run over is to form and level the top of the grade, and the grader draws after it the camp outfit on this last trip, ready for commencing work on another section. This is on prairie roads which cost complete with drainage, including side culverts, about $300 per mile.

In the timbered country costs are higher, and methods necessarily different. The whole road allowance is cleared and the center 33 feet is grubbed ready for the plow or grader, powder being usually required to free the stumps.

Clearing and grubbing will usually average about $100 per mile; discing, grader work and trueing to crown, with the cost of burning the brush, will usually amount to another $125 per mile. Nearly always an amount of corduroy or willow mat is required for crossing soft and wet places at a cost of $2.50 per rod. In this class of country an amount of this work is required averaging out at $150 per mile. The total cost of these roads is from $600 to $1,000 per mile.

Alberta has 15,800 miles of continuous graded roads, 28,500 miles of road fills made and culverts placed, but not continuous and 12,500 miles of unimproved road allowances. In addition to these there are 3,000 miles of trails in remote districts and about 8,000 miles of roads in the settled portions that are not opened to traffic. 300 miles only have been surfaced with material other than that obtained from the material in the side ditches.

3,000 miles of road are on interurban routes and subjected to heavy traffic, while another 3,000 miles of market roads are not standing up and are in need of early attention.

Quebec Spending $8,000,000 This Year

Hon. J. L. Perron, Minister of Highways, Explains the Highway Policy of Quebec Province—10,000 Miles of Improved Roads will be Completed in Three Years

The Hon. J. L. Perron, in a very able address, described the road policy of the province of Quebec, where he is Minister of Roads. As the policy was originally framed by the legislature in 1912, the principle was incorporated of giving chief consideration to the needs and requirements of the rural districts. Although at the time the automobile as a controlling factor of the problem was not thought of but has since come to the fore as a principal phase of the situation, the original principle has never been lost sight of, and the government has consistently adopted a ratio of 2 or 3 to 1 in favor of the rural road as regards the amount of money appropriated annually under the Highways Act.

In 1912, when the present Act was passed, a survey of the provincial roads showed a total of 40,000 miles, of which 10,000 were reported as in need of reconstruction. The responsibility was placed upon the municipalities, the government supplying funds at 2%, with repayment arranged in 41 annual instalments. Alternatively, the government would provide 50% of the cost of the roads outright. The rate of interest had to be raised during the war, and now stands at 3%. Starting with an appropriation of $1,000,000 under this scheme in 1912, varying amounts have been expended from year to year, and the program for the ensuing fiscal year is anticipated to be in the neighborhood of $8,000,000.

Five thousand miles of the program of 10,000 miles included in the program of 1912 will have been completed by the end of the present season, in spite of the delays occasioned by the war and financial stringency, and it is confidently expected that the remaining 5,000 miles will be completed within three years. In addition to the annual list of rural roads, several long stretches of through roads for motor traffic have been completed, including a connection New York to Montreal, Montreal to White Mountains, the Sherbrooke-Derby Road, Montreal to Quebec, the Levis-Jacklin Road to the state of Maine, and a road to the Laurentian mountains, 60 miles of which is now completed and an equal amount on next year's program.

The Financial Side

The great object always held before the department on the financial side of the question, is that the burden of taxes must be kept down as low as possible. Only in very exceptional cases are hard surfaced roads authorized, the general policy of the government being to make use of the material on the ground for road construction. Thus where gravel is available a gravel road is built, and so forth. Special attention is paid to maintenance problems, the provincial government bearing a proportion of the cost. The government has also developed an efficient system of section maintenance which will on application take over the entire responsibility of road maintenance from the municipalities at a cost much lower than the work could be done by the local authorities.

In the ten years during which the highway act has been in operation, the development of the motor as a factor in the road problem has been remarkable. In 1912 the motor car was a rich man's vehicle. Today there are 60,000 motors registered in the province, and during the summer another 40,000 or 50,000 cars come in from outside. In addition there are 4,000 trucks, some of which have been carrying loads as heavy as 36,000 lbs. The damage to roads resulting from this excessive loading has resulted in limitation by law to a maximum of 25,000 lbs. as the only possible solution of a danger to the road system which was becoming exceedingly serious.

Sewer Construction May be Jeopardized by the Employment of Unskilled Labor

The construction of sewers is often advocated as a means of employing unskilled labor. But those who undertake sewer construction as a business know that only a small proportion of really unskilled labor can be employed if the work is to be carried out efficiently and economically. Serious accidents and often loss of life have been caused by employing inexperienced men to timber trenches. Pipe laying should always be done by experienced men as on the pipe laying and jointing depends the stability of the sewer.

Municipalities employing labor on sewer construction as relief work will be well advised to see that a sufficient number of experienced and thus skilled labor, is employed, otherwise there is great danger that their whole capital outlay will be jeopardized. —From "The Pyramid" published by the Vitrified Clay Pipe Publicity Bureau, Toronto.

Development of Asphaltic Concrete

The Merits of this Type of Pavement—Evolution of the Bituminous Road and Improvements in the Methods of Construction

By R. G. DAVIDSON
Portland, Ore.

In the consideration of asphaltic concrete, three important characteristics should have our attention:

1. Superior water-proofing qualities: Asphalt is the oldest water-proof adhesive known to man. Asphalt deposits in Southern California have yielded hundreds of complete skeletons of prehistoric animals in a perfect state of preservation after a period estimated at 200,000 years. This pre-eminent water-proofing quality is particularly important in pavements, the chief enemy of which is water.

2. Heavy traffic requires asphaltic concrete surface to be durable: Most of the heavily travelled roads in the world including the thoroughfares of New York City, are paved with asphaltic pavements, many of which are over 20 years old and still serviceable. Based on the satisfactory experience with asphaltic pavements, all important cities use it to resist heavy traffic.

3. Extent of use of asphaltic surfaces: Statistics show that over 55% of all city paving of the higher grades are of asphaltic types, while less than 3% are of the rigid, non-yielding types. Including city and rural highways, the asphaltic types predominated over the rigid types for the year 1921, there being over 68,000,000 yards of new construction of asphaltic types during that year.

Recognized Advantages

The recognized advantages of bituminous pavements, in general, are:

1. Durability: As proved by pavements and road surfaces in use upwards of twenty years and still in serviceable condition.

2. Resiliency: Ability to take the impact of traffic without cracking, which impact is known to do so much damage to rigid pavements. Tests have demonstrated that it takes upwards of fifty times as many blows to shatter a six-inch bituminous pavement as it takes to shatter a rigid pavement of the same thickness. This resilient surface results in less repair to the automobile or auto-truck itself, as the bituminous surface minimizes the shaking of the car or truck, due to the shock-absorbing character of the wearing surface, which augments the shock-absorbing appliances of the truck rather than working against it as do rigid surfaces.

3. Greater tire mileage: The cushioning effect of a bituminous pavement on the tire results in less friction between the tire and the pavement surface than exists with a tire travelling over a rigid pavement. A bituminous pavement can be brought to any degree of roughness by the rolling into the surface of torpedo gravel or stone; but safety to the average careful driver does not make the rough surface desirable in the light of the economic loss through wear on the tires which would be caused by rough surfaces. Assuming each automobile spends annually $100.00 on tires, it can be shown that even a 10% saving through greater mileage on tires travelling over bituminous paving would mean a saving to the owners of cars in British Columbia, Washington, Oregon, and California of upwards of $10,000,000. annually on the 1,000,000 odd licenses issued in these states; and as affecting the entire country would mean over $100,000,000 per year saving.

4. Construction inconvenience and detours minimized: In building bituminous roads, traffic can be maintained over the work during construction, and a great loss through inconvenience to the owners of cars and excessive detours and delays for long periods are avoided.

5. Ease of maintenance and upkeep: Where sub-foundations under the pavement give way, due to inadequate drainage or otherwise, the surface of bituminous paving can be built up and brought to proper contour by adding new bituminous material to the road in the places affected, and this without barricading the roads for several weeks and thereby delaying and detouring traffic.

A bituminous road can be perpetuated by periodical applications of liquid asphalt and stone screenings, which adhere to the surface and extend the life of the pavement.

If, in later years, traffic has increased to make reinforcement desirable, and the sub-foundation has settled in places, weakening the pavement and causing the surface to present an uneven contour, the old surface can be given a coating of liquified asphalt and an additional thickness of bituminous material can be spread over the old pavement, and will effectively stick to the old pavement and will become one with it. The additional thickness acts as a reinforcement over the weakened places and reproduces the original satisfactory contour, thus utilizing to a maximum degree both the old and new material in the reinforced structure.

6. No glare to the road surface: The dull gray of the bituminous road surface has no detrimental effect on the eye.

7. Home Products: Utilizing local materials in the vicinity where the road is built is a point in favor of bituminous pavements. All materials used in bituminous pavements are on the open market, so that the widest competition is possible in its construction.

Asphaltic Concrete on Any Type of Base

The principal type of asphaltic pavement laid today is asphaltic concrete, being laid on any suitable base; but, generally speaking, one of the four following types of base is used:

1. Compressed crushed stone or macadam base.

2. Asphaltic Concrete, commonly called "black" base.

3. Hydraulic concrete base.

4. Old macadam, concrete or brick pavements, as the case may be, utilized as a base to be resurfaced with asphaltic concrete.

Each of these bases has its place. However, the trend of the time is toward the increased use of macadam or asphaltic concrete base, as these bases assist the wearing surface in taking without injury the blow or impact of traffic. Recent tests made to determine the effect of impact on road surfaces have shown that an asphaltic concrete pavement on an asphaltic concrete base will withstand ten times as many blows from a 125-lb. iron ball falling through a height of six inches at the rate of 30 blows per minute as two inches of the same pavement will stand where same is laid on a rigid base (hydraulic concrete) of the same thickness.

The impact of fast-moving vehicles is the all important factor that must be met to a maximum degree if road surfaces are to last a long period of years. Continual jarring of any rigid mass is known to cause the "fatigue" or breaking down of the mass, similar to the crystallization of steel; and the increased use of yielding bases, such as asphaltic concrete, for bituminous pavements is inevitable. The life of bituminous surfaces is greatly extended by the resistance to impact afforded by the somewhat "yielding" base; and as traffic increases the importance of protection from injury caused by impact increases proportionately.

Asphaltic Concrete as a Base

The increased use throughout the country of asphaltic concrete base warrants our putting forward a few pertinent questions and answers regarding asphaltic concrete as a base for bituminous pavements.

1. What is asphaltic concrete base, nicknamed "black" base?

It is carefully proportioned gravel or cushioned stone mixed with sand in proportions of about two parts stone to one part sand, dried, heated and mixed in a paving plant with sufficient melted asphalt to coat and tenaciously cement together the sand and stone when hauled to the roadway, spread and thoroughly rolled with a ten-ton road roller.

2. Has it adequate supporting power?

Its ability to support traffic has been demonstrated for many years in different parts of the United States, commencing in Washington, D. C., over forty years ago, and in California twenty-five years ago. Large yardages have given successful service both on country roads and on city streets for over ten years, under varying climatic and subsoil conditions, including over one hundred cities or counties on the Pacifis Coast—British Columbia, Washington, Oregon, and California.

3. What other attractive qualities does "black" base have?

The bituminous wearing surface is laid while hot upon this asphaltic concrete or "black" base and is welded to and becomes an integral part of the base, thus forming a monolithic pavement from top to bottom without any line of separation between the top or wearing surface and the base. This complete union of the top and the base makes the total pavement more stable and less susceptible to displacement by traffic.

Superiorty of "Black" Base

4. Wherein is "black" base superior to a rigid base?

(a) "Black" base affords adequate supporting strength but is at the same time resilient.

(b) It takes up the blows of passing vehicles by slight compression and springs back to its normal thickness just as does a solid rubber ball when struck by a bat.

(c) "Black" base, due to its rubbery nature, is water-proof, and, as above described, affords a union with the wearing surface that makes the top and base a uniform, dense, strong, yet resilient mass.

(d) "Black" base is so tough and dense that expansion and contraction do not crack it or let the surface waters into either the asphaltic wearing surface or the asphaltic concrete base.

(e) In constructing country roads with "black" base, the construction of detours is not necessary, as the pavement can be used as soon as laid. On city streets it does not interfere with business and does not deprive the people of the use of the street for an indefinite period.

5. In what other particulars does "black" base excel for modern traffic conditions?

In that if the sub-grade has not been uniformly and thoroughly compacted at every point, or if drainage has not been adequately afforded at any place, then if traffic causes local subsidence or a depression in the roadway, the "black" base bends or sags downward with the yielding subsoil but does not crack or break up.

Asphaltic Concrete Road Surfaces

We have discussed the advantages of bituminous pavements without specific reference to types of bituminous road surface. Considerable areas of so-called asphaltic concrete surfaces have been laid using what is known as "Topeka" mixture, topeka being a mixture of aggregate and asphalt, all the aggregate passing a 1/2 inch screen, but about 75% passing a sand screen of 1/10 inch mesh. There have also been considerable areas paved with a modified topeka, containing slightly more 1/2 inch material than above indicated. In all of these pavements the mortar content predominates, and they cannot properly be called asphaltic concrete in the true sense of the term.

It is well here to review the definition of "asphaltic concrete" as adopted by the American Society of Municipal Improvements:

"Bituminous concrete is a pavement consisting of a combination of broken stone and sand, or fine mineral matter, cemented together with a bituminous cement, and which has all its ingredients mechanically mixed before being laid. To be termed a bituminous concrete it must partake of the well-known characteristics of concrete, that is, there must be stone enough in its composition to form an important part thereof and add to its strength and durability; also there must be enough of the mortar constituent, that is, the sand and bituminous cement, to properly support and bond together the largest particles."

The area of these fine mixture pavements above referred to is small compared with the large percentage of true asphaltic concrete roads in Canada and the United States, which have generally been designated as the Warren type.

Warren Brothers Company has been prominently identified in the development of bituminous road construction for the pase twenty-five years, and the present pavement known as the Warren type of asphaltic concrete has advanced to a high state of perfection, a construction having been evolved to meet the changed traffic of the day. The evolution of the Warren type of Ashpaltic Concrete pavement to meet the impact and thrust of modern traffic will be of general interest.

The development of the paving art over a period of fifty years has been a gradual one, and it must be conceded that the perfect street pavement that will meet all demands of the public and the constantly changing traffic conditions has not yet been invented.

Development of the Paving Art

It was found in the early days of sheet asphalt construction that the wearing surface, which was composed of about 90% of sand and 10% of asphalt, and laid about three inches thick, if subjected to heavy traffic, did not possess sufficient stability and consequently, would shove into rolls and ruts under the wheels of traffic. This sand and asphalt wearing surface was thereupon reduced in thickness about one-half and was required to be laid on an intermediate, or so-called binder, course of about the same thickness, composed of broken stones and asphalt which, it was assumed, would not shove on the foundation, and that the compination of these two separate layers would withstand the stress of traffic better than a single layer of sand and asphalt.

After this theory of the asphalt pavement had become standard practice, F. J. Warren, in 1901, invented a wearing surface for a street pavement, and in the patent issued for this invention in 1903, he showed that where the particles of the mineral aggregate in a wearing surface were composed of grains of sand, as in sheet asphalt, the cementing strength of the bituminous cement was not sufficient to withstand the stress of traffic and to hold the two layers in place, and therefore instead of using separate layers the wearing surface should be laid in a single layer, in which the large pieces of stone and fine mineral matter should be indiscriminately mixed from top to bottom, and, if the different sizes of stone were mixed in the proper proportions of each size a much better and more satisfactory result would be accomplished. Surface mixtures prepared in accordance with this invention have been used in approximately eighty million of square yards of street pavement.

A decided improvement had been made in the paving art when the three-inch asphalt wearing surface was reduced in depth by one-half, and a binder course, made of coarse stone, laid between the foundation and the top course, to retard the shoving and rutting which occurred in the sheet asphalt pavement. The two layers, however, were kept separate and distinct and no efforts were made before Warren's invention to advocate that the fine and coarse particles of stone be indiscriminately mixed in the proper proportions from the top to the bottom of the wearing surface, and thereby secure both stability and solidity.

Warren's invention was a decided improvement on the two-layer sheet asphalt method of construction; but, however accurately the different sizes of stone might be graded, and no matter how low the percentage of voids in the mineral aggregate might be reduced, as shown by laboratory tests, it was found that in the practical construction of sheet pavement under his method the surface would show voids or pores, even though the wearing surface was thoroughly rolled.

Seal Coat of Asphalt

Recognizing this defect and the impossibility of avoiding it. Warren suggested that after the rolling was completed these inevitable small pores or voids in the surface should be sealed, and a flushcoat of pure asphalt covered with stone chips was adopted as the most approved method of finishing a street pavement, this method of construction being consistently followed until later years when an invention in 1910, by E. C. Wallace, provided a structure better able to withstand the great increase in traffic which was apparent to all students of the subject.

In the construction of the Warren pavement, experience taught that notwithstanding the exceeding care in gradation of the different sizes of stone and despite the minimum to which the percentage of voids in the mineral aggregate was reduced, if as determined by laboratory tests, the amount of ashpalt used was just sufficient to fill said voids and coat the particles, then after the rolling was completed, more or less of the large particles of stone would necessarily show on the surface, and being exposed to the impact of traffic, the stones would become shattered, allowing moisture to enter the stone, and causing the pavement to begin disintegrating. On the other hand, if more asphalt and fine aggregate were used than was necessary to fill the voids between and coat the larger mineral particles, then, when the pavement was rolled, part of this surplus asphaltic mortar would remain in the body of the pavement and by keeping the larger particles separated to such an extent that they could not interlock properly among themselves, compromise the maximum degree of stability of the pavement, resulting in a tendency of the coarse particles to move on themselves causing an uneven contour, especially on grades.

After struggling with the problem for several years, and after resorting to several methods to remedy the inherent weaknesses of the earlier Warren construction to meet the greatly increased traffic, the invention of Wallace was evolved and was immediately recognized to be a forward step in the building of bituminous pavements, and was adopted by Warren Brothers Company to be utilized as the increase of traffic required.

Wallace showed that the surface of a coarse aggregate asphaltic concrete could be sealed by a thin layer of fine aggregate asphaltic mixture if it was so blended and bonded with the top of the coarse mixture that the two would form a single, compact, integral layer.

This was a most decided improvement and a radical departure from all previous known bituminous pavements, because in addition to this providing a dense, compact, plastic, protective covering for the coarse stones, it utilized one of the fundamental principles of the old macadam construction by forcing enough of the fine mixture of the upper course down into the spaces between the uppermost coarser particles of the coarse mixture to give the tops of said stones the lateral support which they needed to prevent displacement by traffic.

Crowding of Excess Mortar

It is recognized that in isolated cases of earlier pavements the wedging of the coarse aggregate has under gradually increasing and distributing traffic crowded the excess mortar to the surface of the pavement, without the coarse stones moving on themselves, to a degree that has resulted in an unsatisfactory contour. There are also instances where the gradually increasing and well distributed traffic, combined with the effect of the sun's rays during long years of service, has accidentally produced in the structure apparently the very thing that is accomplished at the outset by the construction which is the subject of this paper. That is to say, at the time the road was completed the traffic was not sufficiently heavy, either in total volume or in weight of individual loads, to produce strains in the pavement greater than it could sustain without deformation, notwithstanding the presence of an excess of mortar between the stones in the body of the pavement. However, the effect of the kneading action of traffic in warm weather was to force the stones downward, wedging them more closely together and squeezing the excess mortar upward thus daily slightly increasing the resistance of the aggregate to displacement, and where the increase in traffic was gradual, it automatically produced an equivalent increase of stability in the pavement and finally formed a shock-absorbing, protective mortar or mastic over the stones.

Where time and traffic have worked this transition without displacement of contour, the surface has shown a higher resistance to impact and thrust of modern traffic than any of the pavements lain under the original Warren methods. The result, however, was accidental and cannot be systematically reproduced by those methods under the increased traffic conditions to which a newly laid pavement is immediately subjected today.

Improved With Age

The above explains why many of the older pavements have gradually improved with age through a change in the juxtaposition of the coarse and fine particles, and why they are to-day standing the ravages of the present-day traffic, while a pavement constructed today identical in every particular as to proportions of materials, specifications and methods of laying does not withstand traffic without displacement.

However, we are now able to design and produce in the original construction the form of structure needed to resist the destructive forces of modern traffic, because the protection from abrasion and impact afforded the stones by the fine aggregate rich bituminous mixture at the immediate upper surface permits the use of a coarse aggregate bituminous concrete for the lower portion which contains a minimum of mortar and a maximum of interlocking of the stones, imparting a maximum of stability to the whole mass.

The traffic of to-day differs from earlier traffic in the following respects:

(a) It is over ten times greater in quality.

(b) Horse drawn vehicles are practically eliminated.

(c) Increase in velocity of the motor-truck or car over that of horse-drawn vehicles.

(d) Concentrated traffic. The highways are now 16 to 20 feet in width, and the traffic is, consequently, confined to narrow strips in one direction.

Under these changed conditions, we have referred to a tendency for the particles of aggregate to become displaced; and, under exaggerated conditions of traffic, particularly on grades, bituminous pavements have shown a tendency to rut or creep under the thrust of the fast-moving motor-car.

Protective Coating

Warren realized that where coarse aggregate is used in the two-inch asphaltic concrete mixture there are bound to be chinks or creases in the surface after rolling that must be grouted or filled; otherwise there would be on opportunity for moisture to be trapped in the surface. All stones are more or less absorbent if not protected by the coating of bituminous cement, it was of course desirable to avoid any absorption of moisture or acids in the immediate surface of the pavement where the moisture came in cantact with it; and since this part of the pavement is subjected to the direct action of traffic some protective coating is all the more desirable. In adopting a specification for bitulithic pavement, which was the name Warren applied to the highest type of construction which he was able to evolve under his invention of twenty years ago, he included the use of a pure liquid bituminous cement flushcoat or squeegee coat. This flushcoat was spread over the surface of the surface mixture in order to fill any surface chinks and seal the immediate surface against the action of moisture, which otherwise might work into the stone by absorption or enter the pavement through any chinks where the stones came together in the surface with insufficient mortar at that point to squeeze up and "close up" the surface.

As the liquid flushcoat did not produce a satisfactory surface finish, being very slippery when it was cold and sticky when it was hot, provision was made for spreading hot stone chips over the liquid flushcoat while the latter was still warm. It was intended that the rolling during construction, plus traffic, would crush and incorporate the chips into the asphaltic cement and thereby give a "body" to the otherwise pure asphaltic cement finish, and make it tough and less brittle. That this was very imperfectly done was evidenced by:

(a) The early disappearance of the surface finish, leaving the stone in the rolled surface aggregate exposed to the shattering impact of traffic.

(b) The necessity for resanding of the pavement, due to an excess amount of liquid asphalt on the surface of the pavement making the immediate surface sticky and objectionable to both pedestrians and vehicles, and making a reapplication of the chips or sand necessary to temporarily remove the nuisance. In many cases, it was necessary to re-apply the chips and sand in successive years.

Not only was the re-application of these chips or the sand an expense to either contractor or city, but the accompanying dust nuisance—both when the original pavement was thrown open to traffic and whenever resanding became necessary—gave rise to criticism, especially on heavily travelled thoroughfares.

Changes in Construction

In order to overcome these weaknesses, it seemed desirable to use a wearing surface mixture containing sufficient fine mortar to produce a smooth "closed-up" surface under the roller, so that less flushcoat would be needed to seal the surface chinks.

Maximum degree of stability and lowest percentage of voids in the aggregate require that the large and smaller stones touch each other with only sufficient asphaltic mortar between the coarser particles to fill the spaces between the stones without crowding them apart. Such a mixture, however, was found to have a more honeycombed surface after compression than was desirable. Such a mixture failed to "close up" under the roller, there being only sufficient mortar to fill the spaces in the coarse aggregate, and not an excess to squeeze up under the rolling to produce a "closed" surface. On wide streets, allowing distribution of traffic over the entire width, and with the class of traffic which prevailed during the earlier development of the bitulithic pavement, this excess mortar or mastic produced no apparent defect in the construction, and the pavement had a degree of stability sufficiently high to meet the traffic of the day. But under the increased impact and thrust of motor traffic and the narrowing of lanes of traffic on the highways, resulting in the confining of the increased traffic to one place, there was brought about a new condition which required a change in the construction to overcome to a maximum degree the tendency towards rutting of the road and the tendency to shift on grades.

It was found by an examination of pavements that had rutted or shifted under extreme conditions of traffic that the excess asphaltic mortar cement which was put into the mixture (to "close" it on the immediate surface) over and above that required to fill the spaces between the coarse stones, resulted in crowding the large stones in the mixture slightly apart, as a portion of the excess mortar content was distributed through the mass. This excess mortar content, or mastic, permitted a slight movement ot the coarser stones on themselves, and yet the excess flushcoat could not be reduced by any other then known way of laying the pavement than by using the excess mortar content in the surface mixture itself. There was a dilemma. Either we had a pavement with a maximum degree of stability and lowest voids, having a course open surface which would take excess flushcoat with its serious consequences described above; or the mixture, while constructed with low voids and a high degree of stability in the aggregate as compared with other forms of bituminous pavements, would not have the maximum degree of stability so essential to meet the thrust of present-day traffic.

Overcoming Early Difficulties

To meet these traffic conditions the herein described changes have now been generally adopted as the Warren type of construction. Instead of making the liquid flushcoat a part of the construction, with its consequent accompanying sacrifice of maximum stability in order to get a "closed-up" mixture, and to minimize the sticky surface and dust nuisance, the improved construction abandons the liquid flushcoat, and provides a construction of the wearing surface by first spreading the coarser mixture with only sufficient mortar content to fill the spaces or voids between the coarse aggregate, thus retaining in the coarse aggregate a maximum degree of stability or resistance to displacement; and immediately thereafter, spreading a rich, plastic, shock-absorbing asphaltic mortar over the coarse mixture sufficient in quantity to thoroughly cover the stable, coarse aggregate mixture. The two mixtures—the fine mastic, with its underlying coarse stable aggregate—are blended together by compression whereby they are bonded, resulting in a pavement consisting of a flexible malleable mastic top to take the impact and shock of traffic and protect the coarse stones from abrasion, blended into the underlying coarse aggregate mixture, with its maximum degree of stability to resist displacement, and effectively wedging the coarse stones, and through the lateral pressure thereby created, giving to the tops of the stones the lateral support which they need to prevent movement under the thrust of the fast-moving vehicle.

In this construction, the fine surfacing mixture or mastic is accurately proportioned, mechanically mixed and uniformly distributed over the coarse aggregate, whereas under the earlier construction traffic was mainly depended upon to force the sand or stone chips into the liquid flushcoat. This the traffic did more or less ineffectively, depending upon the amount of traffic and the weather conditions during which the traffic was applied.

Not Comparable to Sheet Ashpalt

The rich mastic flexible top blended into the coarse aggregate, whereby it is bonded into one integral mass, densest at the top, must not be confused with the ordinary sand mixture in ordinary asphalt pavement as laid on the older binder course. If such a rich mixture were laid to approximately the thickness of sheet asphalt wearing surface, vehicle wheels would badly rut and displace it. In the fine surfacing mixture the coatings of asphalt over the particles are much thicker than they are over the particles of sand in a sheet asphalt pavement. The asphalt is sufficient in quantity to fill the voids in the fine surfacing mixture under ultimate compression, while such is not the case in ordinary sheet asphalt pavement in which such a rich, flexible mortar could not be used to any appreciable thickness owing to its plasticity, but is very effective as a fine surfacing over a stable mixture into which it is blended and bonded into one integral mass. The flexible rich surfacing mixture or mastic and the stable, coarse aggregate are blended together by compression, while both are hot and pliable, producing a structure with a maximum degree of resistance to displacement by the thrust of traffic throughout the body of the structure, and with a maximum ability to receive and absorb the shock and impact of traffic and thereby prevent the shattering of or damage to the structure below.

This construction was first laid in 1910 and the pavements were placed under observation under varying conditions of climate, subsoil and traffic. After several years' successful use. in which the utility of the new construction was demonstrated beyond question, specifications were adopted and issued to introduce the improved construction as the increased traffic demanded it.

Summary of Advantages

The novelty and utility of the improved pavement structure evolved from earlier Warren pavements may be summarized as follows:

(a) A structure most stable and weight-resisting at the bottom.

(b) A structure most compact, malleable, wear-resistant, and water-resistant at the top.

(c) A structure which, when completed, is not uniform in composition or physical characteristics throughout its depth; which, when completed, is not composed of two separate distinct layers of dissimilar composition and characteristics, but on the other hand, is one integral mass, in which the change from the composition of the coarse mixture of the lower portion is not sudden, but is a gradual transition through the zone of blending, whereby the physical characteristics of rigidity and stability of the lower portion pass imperceptibly into the plasticity and malleability of the uppermost portion.

The fine surfacing mixture may be made to present any desirable degree of gritty surface, and where desired for steep grades, may be further roughed by the rolling into it of coarser mineral particles.

It was decided to leave the selection of the next convention city to the board of directors. A number of cities have extended invitations.

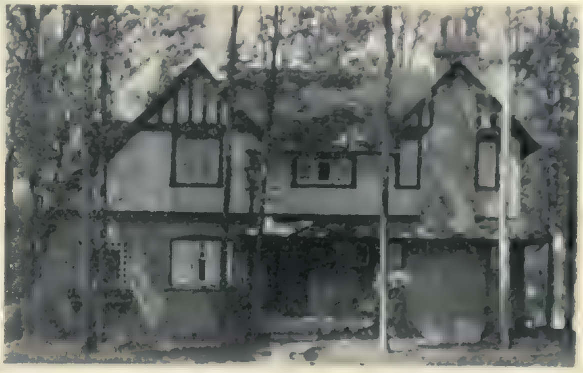
The Contract Record's

Weekly House Suggestion No. 24

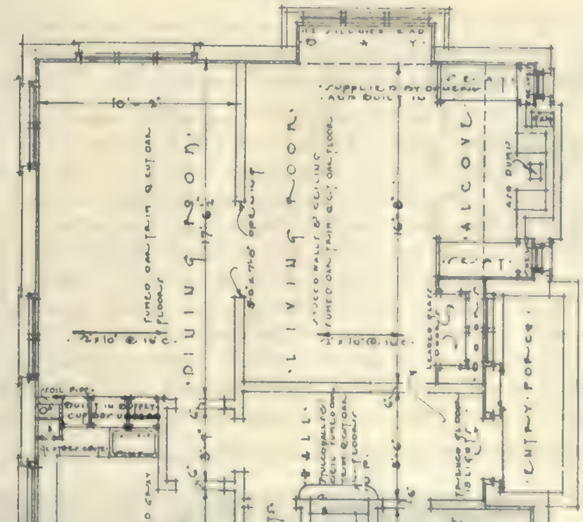
The large, attractive brick and stucco residence, which is the subject of our article this week, was built in the Beach District, Toronto, by Mr. H. Addison Johnston, who has built a large number of the beautiful homes in this district and in other parts of the city and surrounding districts. This house is constructed of red pressed brick to the second floor, with stucco on metal lath above, the roof being of wooden shingles, stained green. The interior throughout is well supplied with natural light through numerous well-placed and attractively finished window openings on all sides of the house.

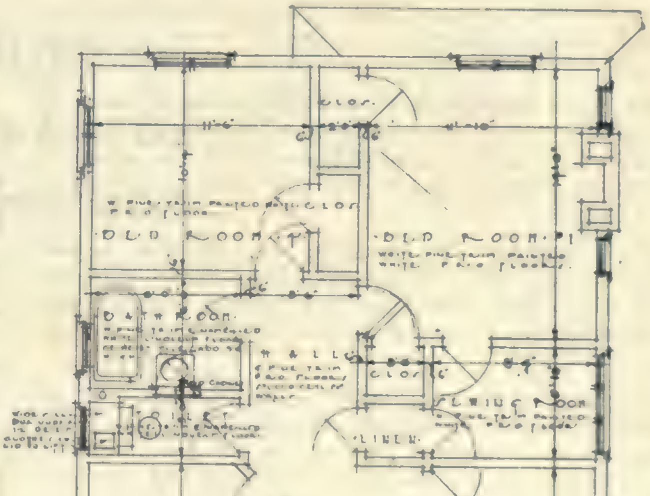
The completeness of detail in the accompanying floor plans makes it unnecessary to say much in regard to the layout and finish of the first and bedroom floors. A glance at these plans immediately suggests to the reader careful attention on the part of the designer to the layout of rooms with regard to convenient location relative to one another, and thoroughness in the supplying of cupboard, closet and other service features in the various rooms. The kitchen, breakfast alcove and dining room are especially replete with these various service features, as seen in the interior views reproduced herewith. There is a service opening from the kitchen to the built-in buffet in the dining room.

There is a basement under the full area of the house, divided into workshop, laundry—equipped with built-in tubs and receptacle for soiled clothes at the bottom of the chute—coal and fruit storage space, and furnace room.



Mr. H. Addison Johnston, 13 Silverbirch Ave., Toronto, as mentioned above, designed and built this residence.





See page 614 for interior views.

Mr. John Wilson Opens Office

Mr. John Wilson, late of the George A. Fuller Co. Ltd., has opened an office and will carry on the business of a quantity suveyor and valuator, at room 50, Guarantee Building, Montreal. Mr. Wilson is a well known figure in the building industry of Eastern Canada, having come to this country from Scotland, in 1911, serving in the capacity of estimator with the Peter Lyall & Sons Construction Company, of Montreal, for a period of seven years. He later became connected with the firm of George A. Fuller Co. Ltd., also of Montreal, as engineer, with whom he remained for four years, until just recently deciding to go into business for himself. Mr. Wilson has had extensive experience in supplying contractors with accurate quantities on several large contracts, which included the following: Ottawa Parliament buildings; Winnipeg Parliament Buildings; Union Station, Toronto; Government Examining Warehouses, etc., in Montreal, Ottawa and Toronto; Mount Royal Hotel, Montreal, besides numerous pulp mills, school and university buildings, office buildings, industrial plants, etc.

Mainly Constructional

East and West—From Coast to Coast

The town of Mount Royal, P. Q., has been granted a $300,000 loan by the Metropolitan Housing Commission, for house building purposes.

During 1921 it is reported the province of Quebec constructed 416 miles of good roads. More than 4,000 miles of highway are now being kept in perfect repair in Quebec province.

The pavers engaged on the extensive repair of Toronto's street railway system for the Toronto Transportation Commission, who went out on strike some days ago against a reduction in wages, have returned to work again at the old rate.

The Carmichael Waterproofing Co., at the present time have under way the waterproofing of the Montrose Bridge with 3-ply membrane and asphalt mastic deck. This work is being carried out for the Michigan Central Railway.

A building permit was issued a few days ago, for the erection of the new Kitchener-Waterloo collegiate, at an estimated cost of $400,000. It will be three stories, with a sub-basement, of plain stone and buff brick and will have a roof of concrete and steel.

There is a rumor of the establishing of an automobile assembling plant in Canada by a large British concern, but to date the name of the concern has not been made public. The company manufacture a well known small-type car, which would sell in this country at about $1,000.

A recent ruling of the Superior Court compels the Association of Architects of the Province of Quebec to accept the membership of Mr. E. P. Raymond, the court finding that the petitioner had complied with the association's requirements and had the requisite qualifications to entitle him to full membership in the above organization.

The Northwest Engineering Company, of Green Bay, Wisconsin, manufacturers of crawler cranes and draglines, announce the removal of the general sales offices to 1220 Steger Building, Chicago. Mr. W. W. Mutter, vice-president, has assumed active charge of this office. Activity in the fields reached by the Northwest organization has increased to such a degree that it has been found necessary to operate nights at the Green Bay plant to supply the demand for Northwest products.

The members of the Cleveland Builders Exchange accompanied by their families will spend the week, commencing June 29th at Bigwin Island, Lake of Bays district, making their headquarters at Bigwin Inn. The party will leave by special steamer on the evening of June 29th for Buffalo, from where they will proceed to Huntsville on a special train, leaving Buffalo immediately after breakfast on the day after departure from Cleveland. A complete program of entertainment and sport to fill every hour of their stay at Bigwin has been arranged for the party. The return trip will be made over the same route as going, arriving back in Cleveland on the morning of Thursday, July 6th.

The International Bridge Promotion Committee, at Bridgeburg, Ont., are taking up the matter of securing an immediate start on the widening of the International Bridge at this point. The Buffalo & Fort Erie Bridge Company are endeavoring to secure a charter to construct an international bridge at Fort Erie, but the Minister of Railways & Canals, Mr. W. C. Kennedy, is of the opinion that it would be to the government's interest to enlarge the present international bridge and thereby direct the increased revenue into its own coffers rather than grant a charter to an independent company. Bridgeburg will await tne action of the Private Bills Committee of the Legislature in dealing with the above company's application for a charter.

Personal

Mr. Henry Watson has recently been appointed to take charge of the building department of Messrs. Patten Bros. Ltd., builders and realtors, of Windsor, Ont.

James I. Vincent has been appointed eastern representative of the Chicago Bascule Bridge Company with offices at 30 Church Street, New York. Mr. Vincent, who was graduated from the University of Michigan in 1896, spent several years with bridge fabricating companies and railroads. In 1903 he joined the Scherzer Rolling Lift Bridge Company where, from 1905 to 1912 he was in charge of their New York office except during 1908, which year he spent abroad in charge of the construction of a bridge in Burmah, and in obtaining orders in Europe. From 1912 until recently Mr. Vincent was eastern representative of the Strauss Bascule Bridge Company in charge of the New York office.

Interior views of House Suggestion No. 24.
See page 813 for description

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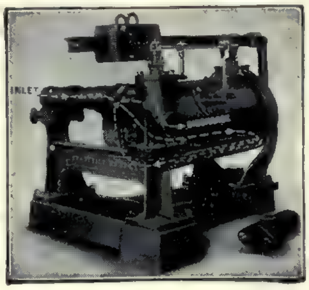

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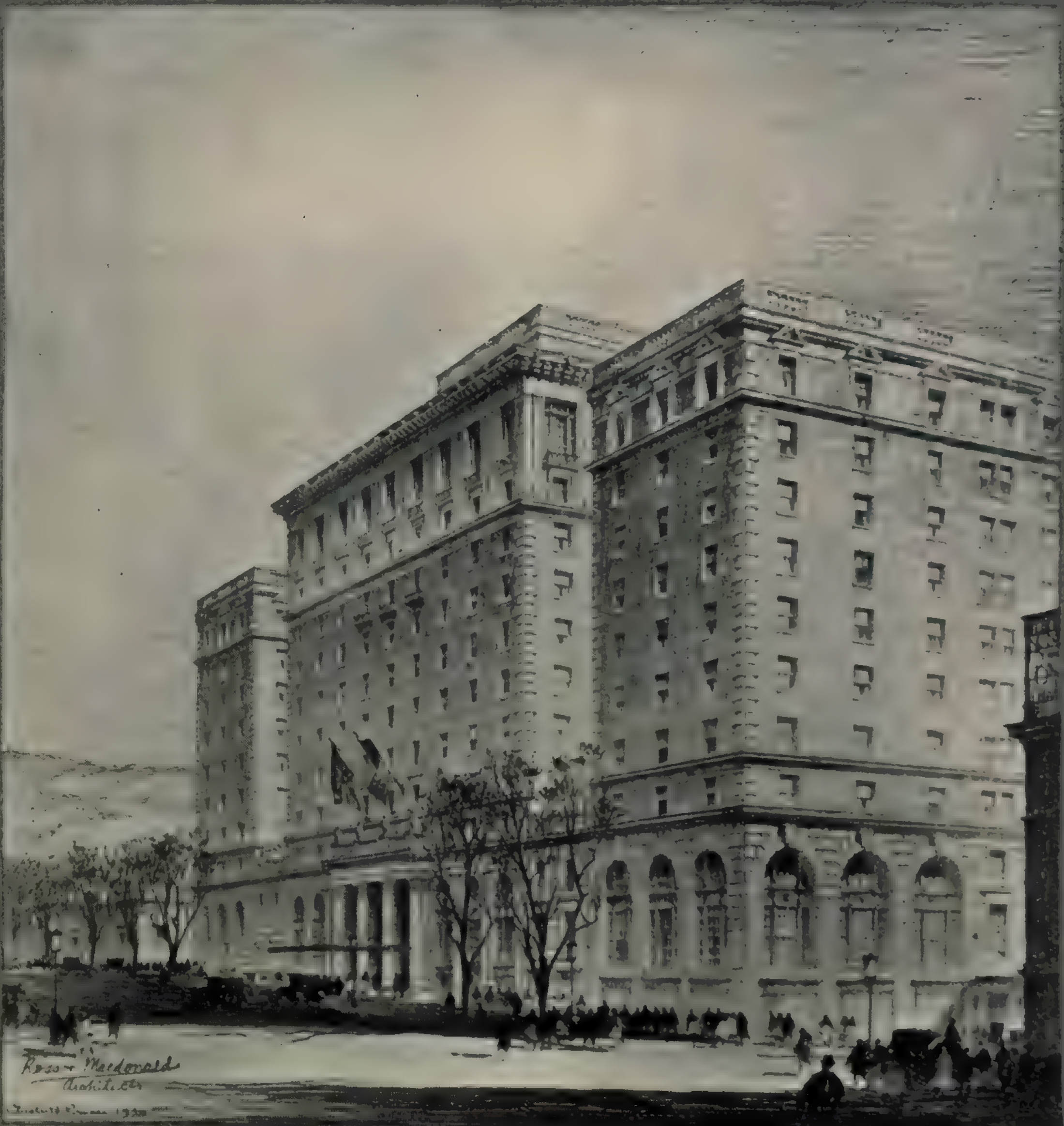


The Mount Royal Hotel, Montreal

One of the Largest Building Undertakings on the Continent

A Comprehensive and Authoritative Article Descirptive of the 1000 Room Hotel Now in Course of Construction in Canada's Metropolis —A Structure Outstanding Because of its Palatial Size, its Architecture, its Cost and the Extent of the Construction Operations Involved

The new Mount Royal hotel under construction in Montreal is probably at the present moment one of the largest building undertakings on the American continent, involving, as it does, a heavy expenditure of money and the employment of a large number of men on the operation itself, as well as in manufacturing plants throughout Canada supplying materials and equipment for the new hotel. There has for a considerable time been no question as to the need of additional hotel accommodation, and an effort has been made in this building to meet this pressing demand.

The architecture of the building is "Georgian" in style, and the materials selected are incorporated admirably in the style adopted. These materials consist of Stanstead granite, Canadian Benedict buff stone and Hocking Valley and Upper Kittaning light buff brick. There is a considerable amount of ornamental ironwork, with more or less elaborate detail in keeping with the general treatment of the exterior. The interior design for the public rooms is generally in Italian Renaissance. In the selection of materials, and also in the study given to color decoration, it is expected that this building will be rather unique and will have a strong appeal to the most exacting and appreciative of hotel patronage.

Every requirement of the hotel guest has been carefully considered in the designing of the building. There will be thus 1046 bedrooms, each, except special suites, having a separate bath, the rooms varying in size to meet the needs not only of the travelling man, but also the large amount of tourist business, which, for some time past, has been directed toward Montreal and Quebec.

As Montreal is becoming more and more a convention centre, special facilities have become necessary to meet this situation in the way of dining rooms and rooms of assembly. To this end, the dining features will be taken care of in the large dining room, cafe, private dining rooms and palm room on the main floor, the grill room and cafeteria on the ground floor and the banquet room on the 8th floor, which will be used as a summer dining room. As places of assembly, the large dining room, also the banquet room and ball room on the 8th floor will be available. These features will also enable the local demands for entertainment to be met for some time to come.

Two other important features in the plan that might be noted are the shops on the ground floor and the offices on the main and mezzanine floors, which will not only meet a demand in the locality, but will also furnish business facilities which, in the large hotels most recently erected, have become quite an important adjunct to regular hotel business.

As may be seen from the plans, five of which are reproduced herewith, the ground floor comprises shops, cafeteria, grill room, barber shop and general toilet; the main floor includes lobby, palm room, main dining room, cafe, main kitchen and offices; the first to eighth bedroom floors are made up of 1,046 guest rooms, with baths. On the ballroom floor are the ballroom, banquet room, convention hall, kitchen and service; a portion of the ballroom mezzanine floor is laid out for the accommodation of housekeepers and for dormitory space.

The outside dimensions of the hotel are 306 x 227 ft. and the height is 10 storeys, the distance to the main roof being 130 ft. The structure comprises a steel frame with the exterior walls supported on steel, 4,500 tons of steel being involved in the construction. The building is faced with Canadian Benedict stone to the first bedroom floor, including a central section from the 8th floor to the roof. The rest of the building is faced with a light buff face brick. All stone work is backed with brick and 2 inch hollow tile split furring, while the face brick is backed with 8 in. hollow tile. About 50,000 cu. ft. of cast stone, 850,000 face brick, 1,113,000 common and hollow brick and 120,000 sq. ft. of hollow tile backing were used. Interior partitions are all hollow tile and gypsum block, the latter comprising 555,000 sq. ft. of the total partition area of 1,223,000 sq. ft.

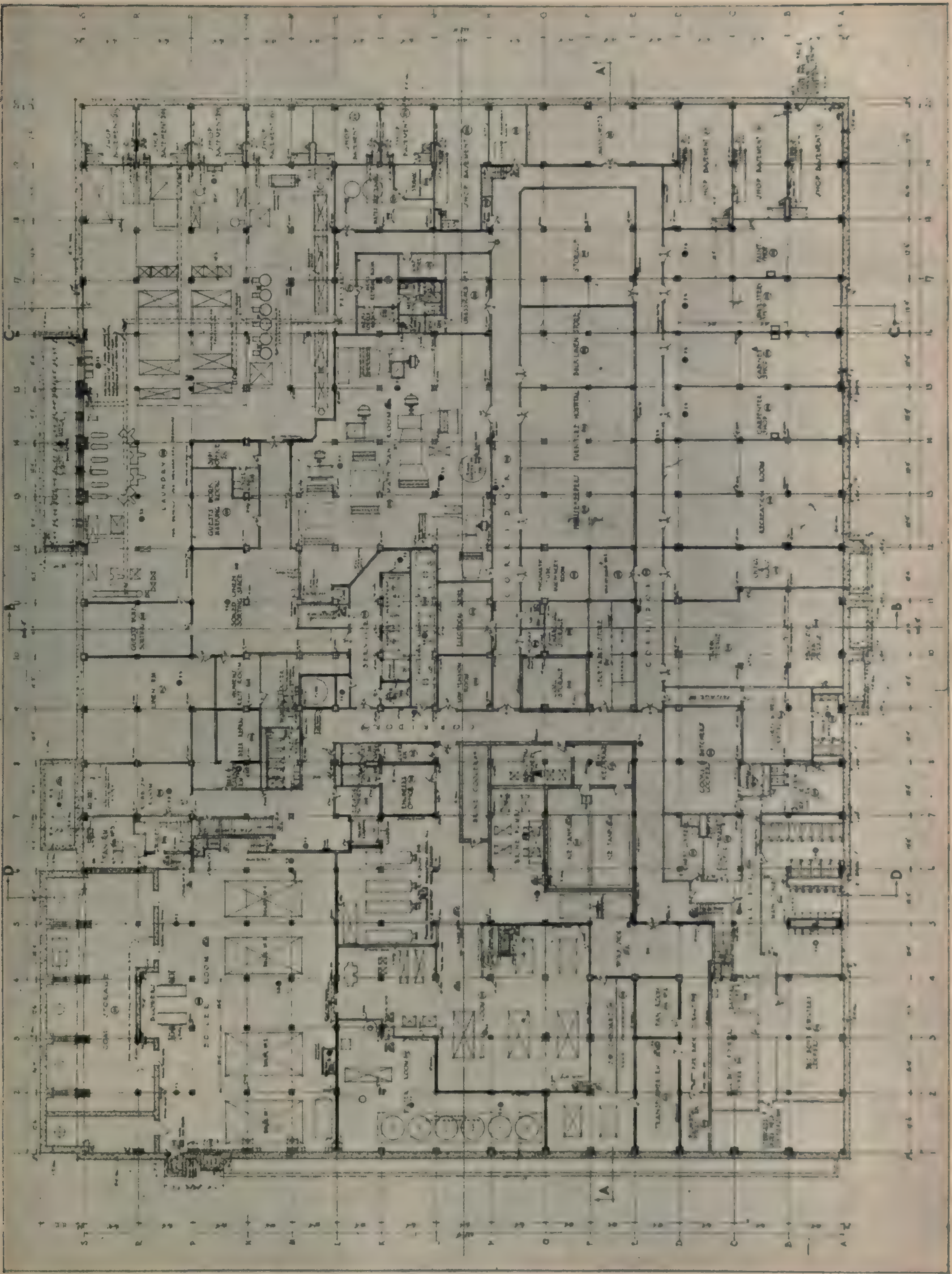
All structural steel is fireproofed first with a trowel coating of mortar and in addition with hollow tile and brick. The floors are all reinforced cinder concrete.

All rooms are finished with plaster walls and ceilings on metal lath. All doors throughout the guest portion are to be of mahogany, while trim will be of gum wood. The bathrooms are to be finished with a wainscotting of marble and floors of ceramic tile. Marble floors and wainscotting are also used in the barber shop and general toilet, while terrazzo is used as a floor border and base throughout the corridors.

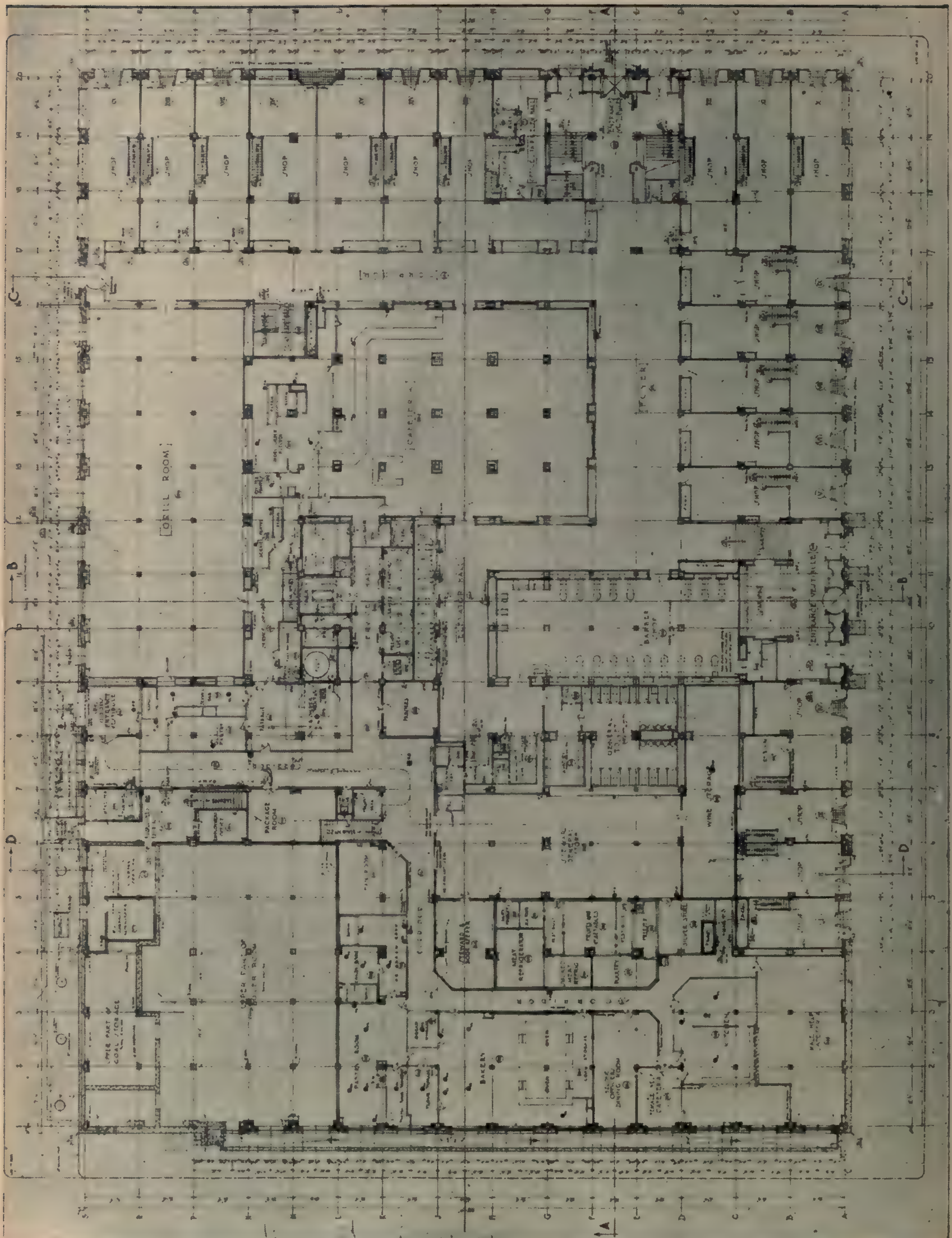
The plan provides for seven passenger elevators, 1 large freight, 2 small freight and 3 service elevators. The public rooms, kitchens, service rooms, locker rooms and all toilets will be mechanically ventilated. The mechanical requirements generally, include a boiler plant, motors to generate light and power, filtration equipment for water circulation, ice making plant and refrigeration, kitchen and laundry equipment, telautograph system, pneumatic tubes, time clocks and stamps. More detailed information regarding these are given in another part of the article.

Foundations

All builders having knowledge of Montreal building conditions know of the section of the city in which this building is being erected. While rock is within

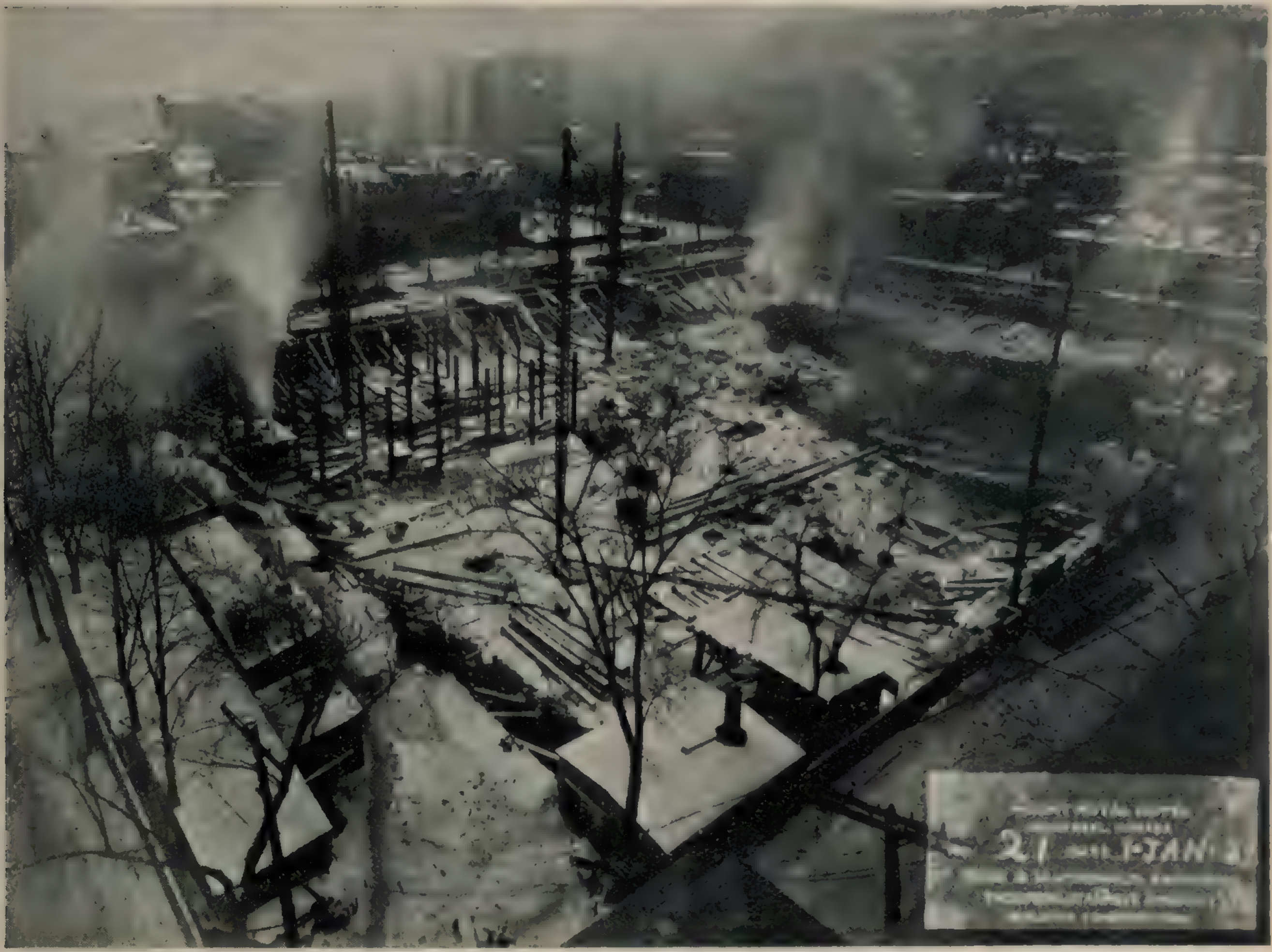


Basement plan, Mount Royal Hotel Montreal—Ross & Macdonald, Architects



Plan of ground floor, Mount Royal Hotel, Montreal—Ross & Macdonald Architects reach, it is necessary to go through varying depths and also varying strata of materials for that purpose. In the case of this building, the average depth of rock below grade is about thirty-five feet. Concrete caissons were determined upon as most suitable for this building and these were sunk to a solid and full bearing on the rock, the total number of caissons being 318.

Owing to the treacherous nature of the soil in which the excavation was made, special care was exercised in the supporting of banks, streets, and surrounding property, which resulted finally in the sinking of caissons, erection of reinforced concrete retaining walls and the filling around them, without failure of any kind. It is remarkable that very little water was encountered in the putting in of the foundations, indicating that the area had previously been well drained, due apparently to other structures having been previously erected and the existence of deep sewers.



Speed has been one of the outstanding features of the construction of the Mount Royal hotel. Compare this view, taken on January 1, 1922, with the illustrations on subsequent pages

Stonework

The stonework, all furnished and set by Canadian Benedict Stone Ltd., Montreal, is of a rich buff hue set over a pink granite base, in the form of an arcade with large circular head openings with massive keys over the arched windows. One of the outstanding features is the main portico, with four large columns and pilasters responding on each side, all with beautifully carved capitals of unique design. The lines of the columns are felt through the balustrade over the portico terminating with elaborately carved urns.

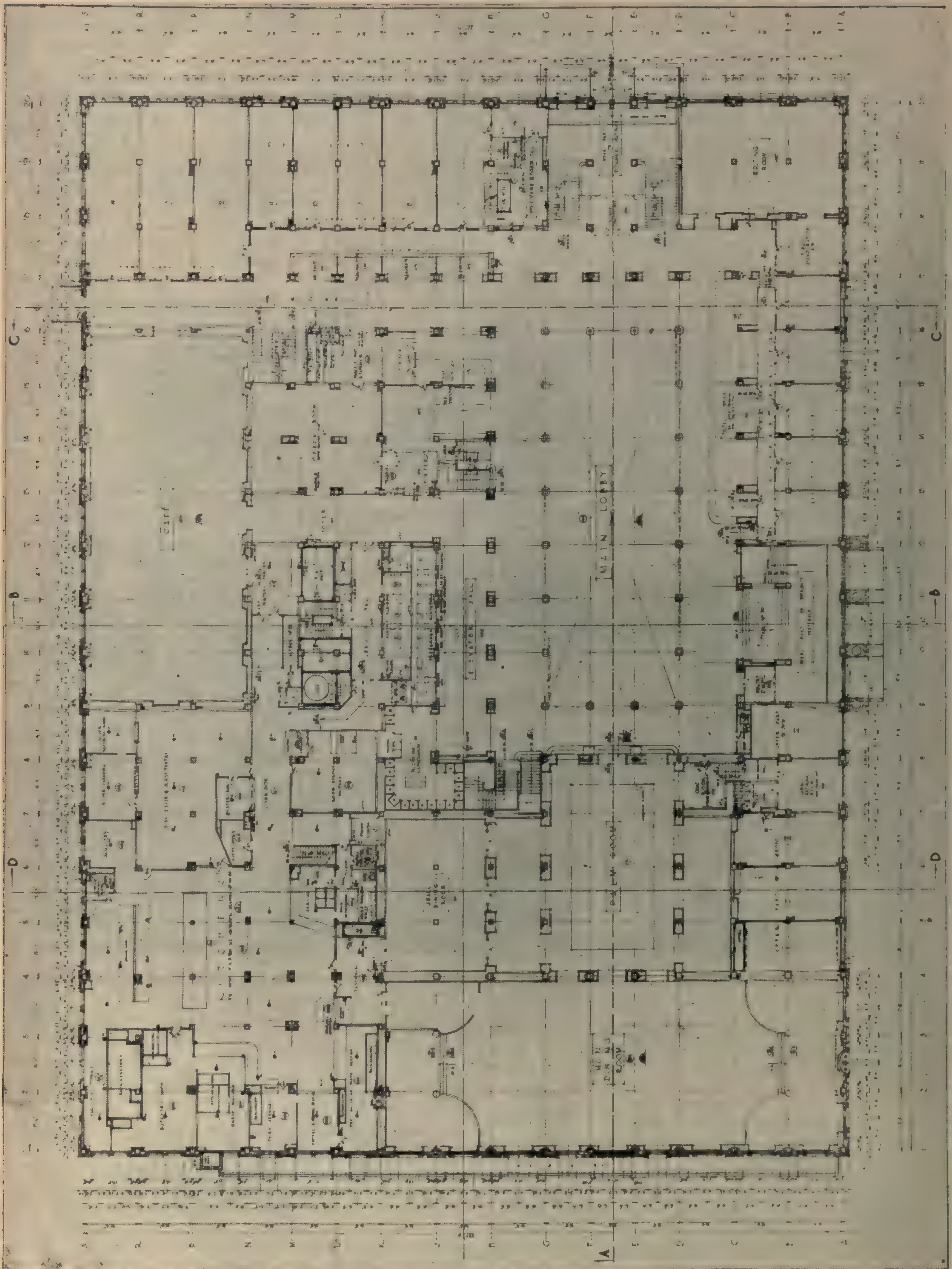
At the end of the dining room on Peel Street, the central feature between windows is a niche to receive flowers, surrounding the base of a richly ornamented vase.

Above the third floor, the building forms a double letter "H" and the foreground of each of the four courts is ornamented with a balustrade, having for a central feature a massive carved cartouche, each weighing over four tons. The fourth storey windows are trimmed with stone and finished with a moulded cornice around the building. The next five stories are faced with brick, the windows having stone sills, and the corners, stone quoins.

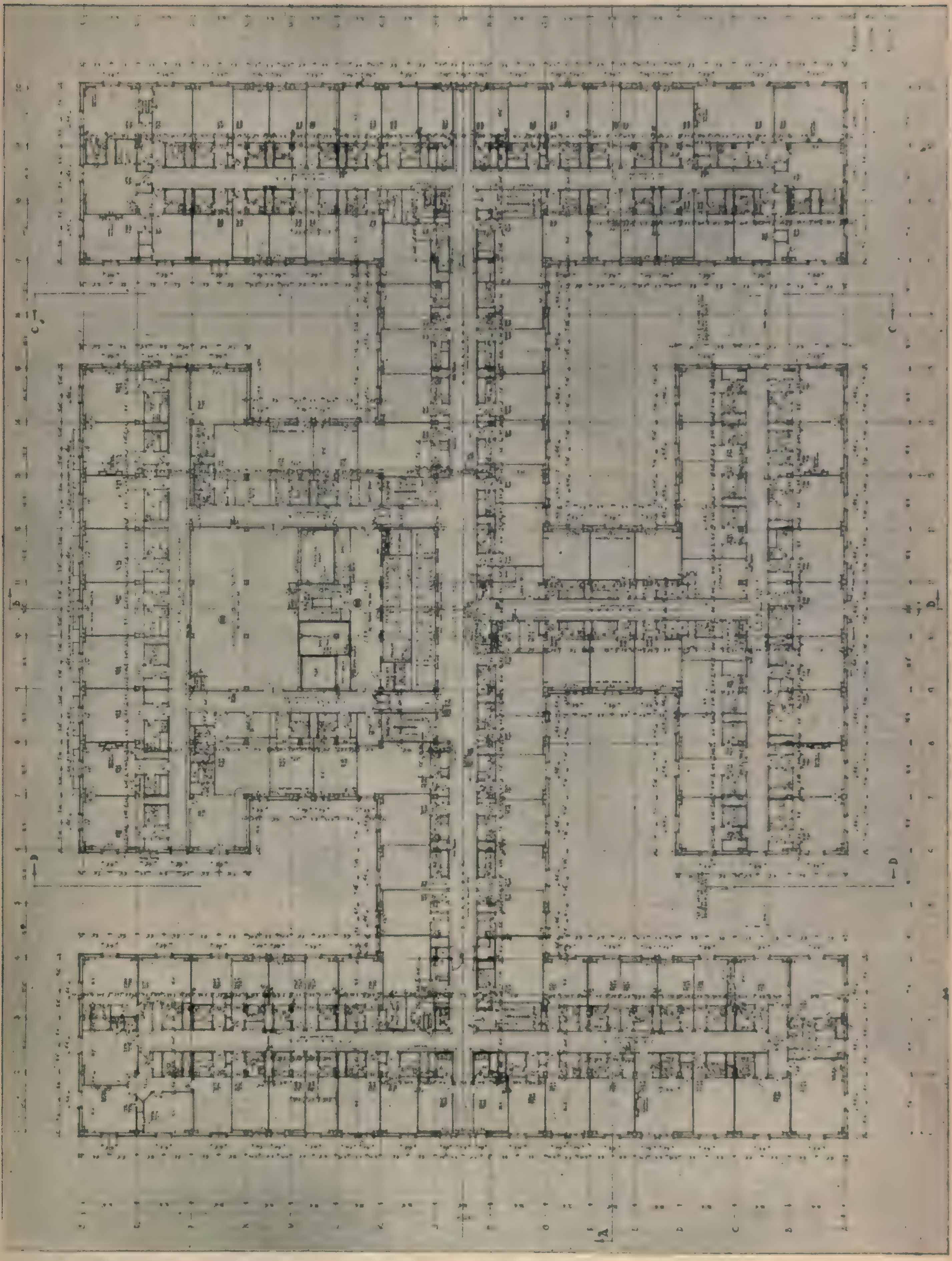
The building is finished with stone trimming for the top storey of the end wings, each window being accentuated with a pediment over it. The last two stories of the centre pavillion enclosing the ball and banquet room on Peel & Metcalfe Sts. are entirely faced with stone relieved with pilasters, having carved capitals. All the sculpturing is done by hand.

Concrete Fireproofing, Floor and Roof Arches and Cement Floors

With the exception of the basement, all the floors are reinforced cinder concrete arches, four inches in thickness. The following method for installing was used: The first operation was to place beam clips on the bottom flanges of the steel beams, Reed and Mitchell Tappan clips being used. The wood forms were next put in place. These were constructed en-



Plan of the main floor, Mount Royal Hotel, Montreal—Ross & Macdonald, Architects



Plan of a typical bedroom floor, Mount Royal Hotel, Montreal—Ross & Macdonald, Architects tirely of 1" x 6" spruce, surfaced on one side and two edges. The joists were first hung on edge, suspended from the steel beams by No. 6 galvanized wire hangers, the lines of the joists running perpendicular to the intermediate steel beams. The beam soffits and beam haunches, previously made up at the benches, were then put in place, after which the bucks running from haunch to haunch were installed and the platform or decking placed on the bucks.

The wire reinforcement used was the American Steel and Wire Company's triangle mesh, and was furnished by the U. S. Steel Products Company. This came in rolls containing about 1,100 square feet each, and was rolled down on the decking and turned down over the spandrel beams.

The electricians then installed such part of their work as was to go in the concrete slab, after which the cinder concrete was placed.

Concreting Plant

The plants for mixing and placing the concrete consisted of four mixers and four bucket hoists. The mixers were: One London, one Ransom, and two Smith tilting, each of one-half yard capacity except the Ransom, which was three-quarters of a yard. Buggies were used for distributing the concrete. Each plant had a capacity of 200 yards per ten hour day, or sufficient concrete to fill the forms installed per day. The cinder concrete consisted of one part cement, two parts sand and five parts cinders.

The forms were stripped by first cutting the wire hangers holding the joists, which then came down; next, by cutting the wire holding the soffits, soffits, haunches, bucks and decking were removed in the order named, and passed vertically up to be used on the sections of the new floor two storeys above. Sufficient forms were provided for three complete floors.

On the arches, as above installed, one inch cement finish is to be placed and trowelled to a hard and smooth finish on all floors where marble, tile or other floor is not provided.

The total area involved is 707,442 square feet, which represents approximately 12,000 cubic yards of concrete. The contract is being carried out by E. E. Davis Company, Limited.

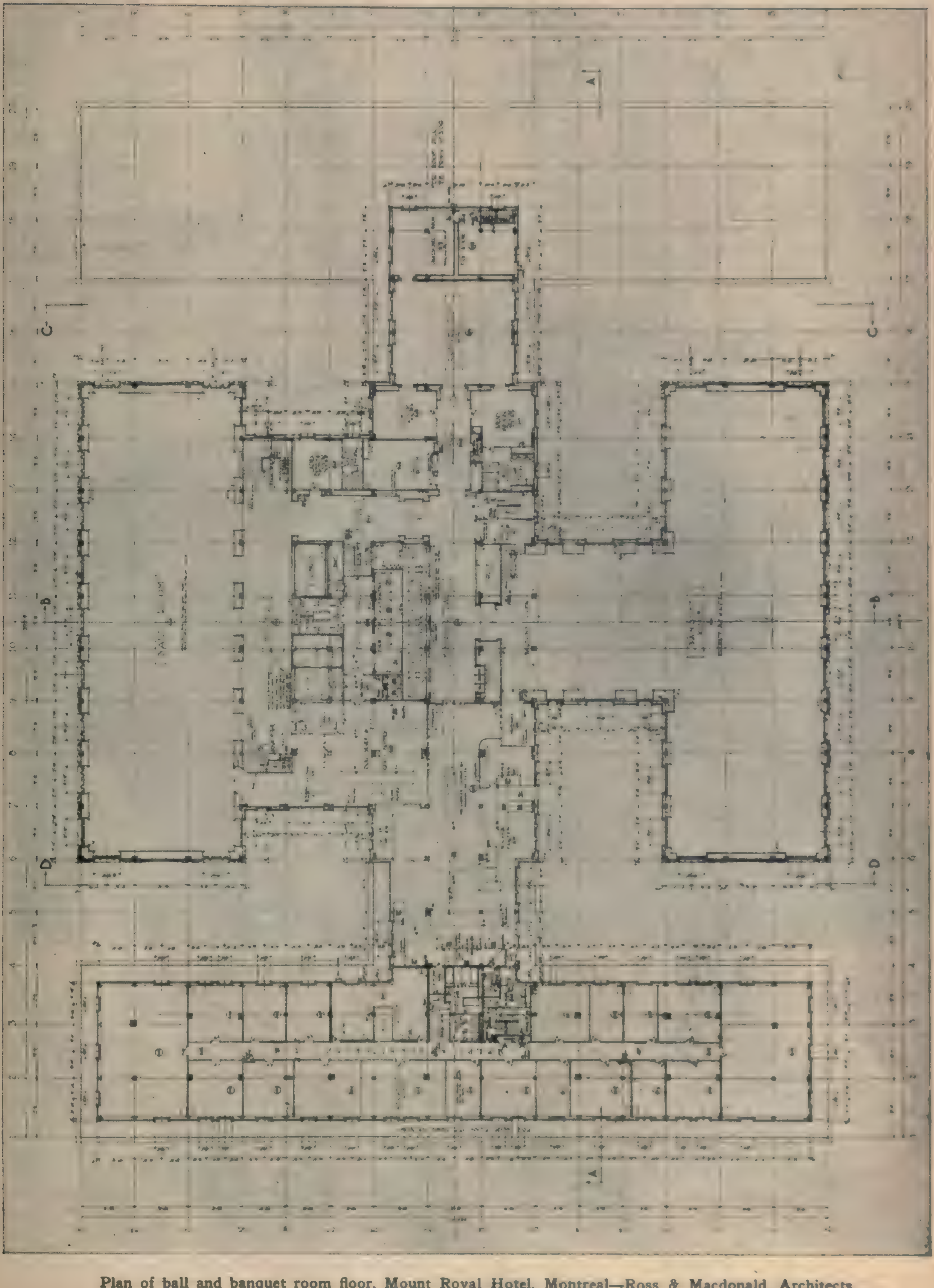
Progress on March 1, 1922. Compare with the picture on page 623

Plastering Contract

The following quantities of material to be used in the plastering will give a good idea of the extensive character of that work. This includes not only the plain plastering, but also the ornamental work covering the special rooms:—90,000 lineal feet 1½" x 1½", 8 gauge angles; 50,000 sq. yds. Lorib ceiling lath; 20,000 sq. yds. expanded metal lath; 400,000 lineal ft. of channel iron; 4,500 tons of sand; 750 tons of plaster of Paris; 3,000 tons of neat hardwall plaster; 1,500 tons of magnesia hydrated lime; 150 tons of bond stone plaster; 75,000 lineal ft. of corner beads.

This work is being carried out by the Interprovincial Plastering Co.

The Ontario Gypsum Co. are supplying all the



Plan of ball and banquet room floor, Mount Royal Hotel, Montreal—Ross & Macdonald, Architects hardwall plaster for the hotel job. The original order calls for 2,000 tons, which is being supplied through Messrs. Stinson, Reeb Builders Supplies, Ltd., Montreal. The hydraulic lime is being supplied by the Alabastine Co., Paris, Ont., the original order calling for 1,000 tons. This contract also calls for a quantity of bond-stone, which is an especially prepared plaster used on concrete surfaces.

Interior Marble

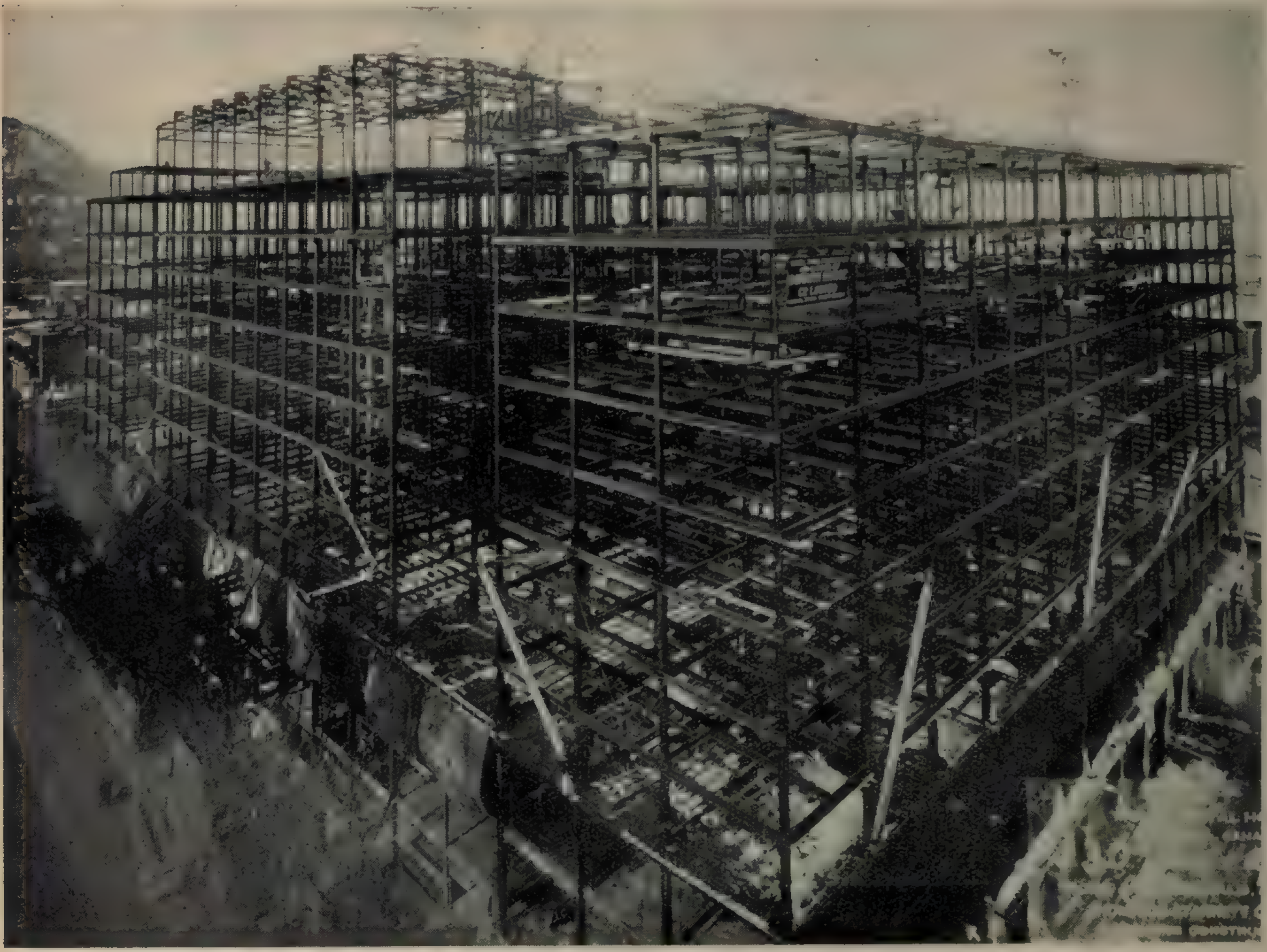
The contract for the interior marble is being executed by Wallace Sandstone Quarries, Ltd. This firm operates the Missisquoi Marble quarries at Philipsburg, Que. Their contract comprises the marble wainscotting and flooring of one thousand bathrooms, and all the tile work in the barber shop, ladies' hair-dressing and manicuring rooms, rest and wash rooms, as well as the marble bases of all public rooms, halls and lobbies. An interesting feature of this contract is the substitution of marble for tile in the bathrooms. Hitherto, English wall tile has been used almost exclusively in work of this kind.

The tile work in connection with this building, includes ceramic tile floors in the bath rooms with black and white border; also quarry tile floors in the kitchens. This work involves approximately 50,000 sq. ft. of floor space. It is being handled by the Italian Mosaic and Marble Co. of Canada.

Plumbing

The plumbing work includes, in general, sanitary piping for plumbing fixtures, rain water leaders, fire lines, and drinking water. Waste and vent piping is generally of cast iron with caulked joints, cold water piping is of galvanized wrought iron pipe, while full weight brass piping and fittings are used for hot water lines. Fire lines are extra heavy with extra heavy fittings. There are approximately 3,300 plumbing fixtures to be installed in the 969 guests' bathrooms and general spaces throughout the building.

All the foregoing piping, fittings and valves, and the entire specification of plumbing fixtures and bathroom accessories are supplied by Crane Limited, Montreal. The vitreous china lavatories and water closets are made by the Canadian Potteries, Limited, St. Johns, Que., while the enameled iron bath tubs of which 923 are being supplied are of Standard Sanitary Manufacturing Co. manufacture. They state that these tubs are for the most part built in the floor, back and end, except for a small percentage, which are built in at the corner and have one end exposed.


The state of the Mount Royal Hotel on April 1, 1922

The plumbing contractor is T. J. Dyer Company.

Water Supply

The water supply for the building is to be taken from the high pressure and low pressure mains of the city of Montreal, and also from an artesian well drilled on the job site. The depth of this well is 895 ft. and its diameter is 10 in. A 10 in. steel casing with drive shoe was inserted from the surface of the ground 12 ft. into the bed rock for the purpose of casing off the 34 ft. of clay, 11 ft. of hard pan and surface waters encountered. The 10 in. well was drilled in through 850 feet of chazy, trenton and calciferous lime stone rock. From two water veins encountered at 362 and 855 ft. a supply of 7,200 gallons of pure water per hour at a temperature of 52 degrees F. was pumped, maintaining a level of 133 ft. from the well top. The water is delivered by means of an Ingersoll-Rand No. 7 type VA Imperial air lift supplied from two 12 x 10 Ingersoll-Rand air compressors, the one for service operation being electrically driven and the one for reserve having steam drive. Special precautions are to be taken to prevent the noise of operation from being transmitted throughout the hotel.

The latest photograph of the Mount Royal Hotel construction taken on June 19, 1922

From these sources cold water is pumped or forced by gravity to two 10,000 gallon storage tanks on the roof with a horizontal overhead distribution main delivering water to all fixtures throughout the building. All water for general house purposes is to be filtered by a battery of Refinite Co's filters and water for laundry purposes is to be treated by a water softening plant which will be installed in the hotel. Drainage water from the basement and boiler room will be pumped to the sewer by three ejector pumps supplied by the Taylor Forbes Co. The combined capacity of these three ejectors will be 850 gallons a minute. Hot water will be supplied by five water heaters with a combined capacity of 19,000 gallons per hour. Heat for these heaters will be furnished by exhaust steam.

Heating and Ventilation

Typical bedroom floors are to be heated by direct radiation with a radiator in each room and in each bathroom. Public spaces and service portions of the building will be heated either by direct radiation, indirect radiation or in some cases both. There is approximately 60,000 square feet of direct radiation to be installed and approximately 2,500 units. Indirect heating and ventilation will be supplied by fans of which there are 10 supply fans and 14 exhaust fans. All interior bathrooms are exhausted into pipe shafts by means of fans on the roof. The heating of special rooms will be generally controlled automatically by an automatic temperature regulating system. High pressure steam mains, exhaust mains, heating mains, risers and branches and returns are covered with 85% magnesia covering where concealed or exposed. Approximately 200 tons of sheet metal duct work are to be installed to transmit the air for the above mentioned fans. All fans are motor driven. Air washers are to be installed on four fans for special room ventilation.

In the heating and ventilating contract the following equipment is involved; Approximately 100,000 ft. of wrought iron pipe; radiators all controlled by modulation valves and thermostatic traps; four vacuum pumps; two boiler feed pumps; one house and fire pump; one feed water heater; steam flow meters, recorders and gauges; tanks and heaters; high pressure steam piping for power, all lap-jointed. The contractor for this work is the Garth Co., Montreal.

Pipe Covering and Insulation Work

All the steam lines; heating lines; hot, cold and drinking water lines; the apparatus in connection with these systems; and a large portion of the indirect heating and ventilating systems are to be insulated in various ways. The steam, heating and hot water lines are being covered with Carey's 85% magnesia pipe insulation, standard, 1-1/2" and double standard thicknesses being used for various sized pipes and services. For the cold water lines the insulation used is Carey's Perfecto (anti-sweat) covering. Cork covering is being applied to the drinking water lines.

The ducts, fans and heaters of the indirect heating system are being insulated with Carey's 85% magnesia blocks (1" thick) and a finishing coat of 1/2" thickness of asbestos cement. A similar insulation is being applied to the apparatus for heating and hot water systems; hair felt and waterproof paper make up the insulation for the filters and other apparatus for the cold and drinking water systems. The fresh air intakes and boiler smoke flue walls are insulated with the same firm's asbestos air cell board. The portion of the smoke flue to 10' below the level of the roof is to be lined with vitrified asbestos sheets.

One of the Largest Insulation Contracts in the Dominion

This is the largest insulation contract in Montreal and one of the largest in the Dominion. The following quantities of materials will be required for the work: 100,000 lineal feet Carey's Magnesia pipe insulation, 17,000 lineal feet Carey's Perfecto cold water insulation, 45,000 square feet Carey's 85% magnesia blocks, 25,000 square feet Carey's air cell board, and 140 tons Carey's magnesia and asbestos cements. The contract is being carried out by William Rutherford and Sons Company, Limited, Montreal.

Boiler and Generating Plant

Steam for heating and power apparatus will be supplied by four Robb boilers having a total normal capacity of 1,400 h.p. These boilers are of the double cross drum water-tube type and will be arranged with the latest type of power dump steam-driven, forced draft automatic stokers of the Taylor Stoker Co's. make which will enable the boilers to be operated at 200% normal radiation, giving a total capacity of 2,800 h.p. Boilers and stokers are arranged for burning soft coal, and the plant will be equipped with the latest type of automatic coal and ash conveying apparatus which will be supplied by the Link Belt Co. Boilers will be arranged with soot blowers. The coal handling equipment is designed to handle 20 tons of coal per hour and ten tons of ashes per hour. The breeching for the boilers will be underground, leading to a steel stack approximately 30 ft. above the roof line. This stack will be unlined except for the portion near the top which is to be lined with Vitrobestos, but the outside of the stack is to be insulated from the surrounding rooms by asbestos board insulation. The boiler breeching is to be of concrete construction lined with fire brick. Boilers are to be brick set and equipped with Turner baffles.

The electric generating plant will consist of two 300 k.w. Westinghouse generators, driven by Belliss & Morcom high speed direct-connected compound vertical engines. Provision is to be made for the addition of a 200 k.w. unit at some future date. Current will be 230 volts direct current for power and 115 volts for lighting. Transformers are to be provided so that the lighting for the building can be obtained from outside sources as well as from the isolated plant. One 300 k.w. and one 200 k.w. motor generator set are to be installed so that 230 volt direct current can be furnished for power and elevators by means of the

Method of placing electrical conduit on forms prior to pouring of floor slab

Conduits and outlet boxes in place ready for partitions

alternating current service from outside mains. The above arrangement ensures two sources of supply at all times. House and fire pumps are to be of the vertical steam driven piston type.

Elevators

The elevator system will consist of six main passenger elevators for the use of guests. These elevators serve ground, main, mezzanine, bedroom and ball room floors and are to be of the 2 to 1 traction type, of 2,500 lbs. capacity and with a speed of 450 ft. per minute. Three service elevators will serve from the basement to the ball room mezzanine floor. These have a capacity of 2,500 lbs and operate at 400 ft. per minute. They are of the worm gear traction type. One combination freight and service elevator, serving from basement to ball room mezzanine floor has a capacity of 3,500 lbs. and a speed of 350 ft. per minute. It is of the worm gear traction type. Another freight elevator of the worm gear traction type, serving from basement to main floor will lift 3,500 lbs at 100 ft. per minute. One passenger elevator for the use of executives and office help will serve the ground, main and mezzanine floors; it will have 2,000 lbs. capacity, a speed of 200 ft. per minute, and be of the worm gear traction type. Two electric dumbwaiters serving the main and ball room floors only, with 200 lbs. capacity at 200 ft. per minute, and with automatic push button control will be installed. One freight elevator of the worm gear traction type and of 1,500 lbs capacity at 50 ft. per minute will serve the ground, main and mezzanine floors. There will also be one electric dumbwaiter serving ground and main floor. This will have 200 lbs. capacity and a speed of 75 ft. per minute; it will have automatic push button control. Elevators are to be provided with a full complement of signal and safety apparatus in accordance with latest recognized practice. The entire equipment will be supplied and installed by the Otis Fensom Elevator Co. Ltd.

The Electrical Contract

The electrical work, installed by the Canadian Comstock Company, Limited, consists of the installation of an 18-panel main lighting and power switchboard in the basement, a sub-panel switchboard in the pent house and 8 power distributing panels in different parts of the building, together with conduit and wiring systems for power, lighting, fire alarm, carriage calls, time-clocks, time-stamps, telautograph, telephone, telegraph, watchman's system and miscellaneous low tension apparatus.

The current for power, which is 230 volts d.c., will be generated in the basement by 2,200 volt synchronous motor generators, and a steam driven generator to be used in case of emergency. The lighting will be 230-115 volts and in general a.c., but the system will also be so arranged to be operated from the d.c. bus-bars.

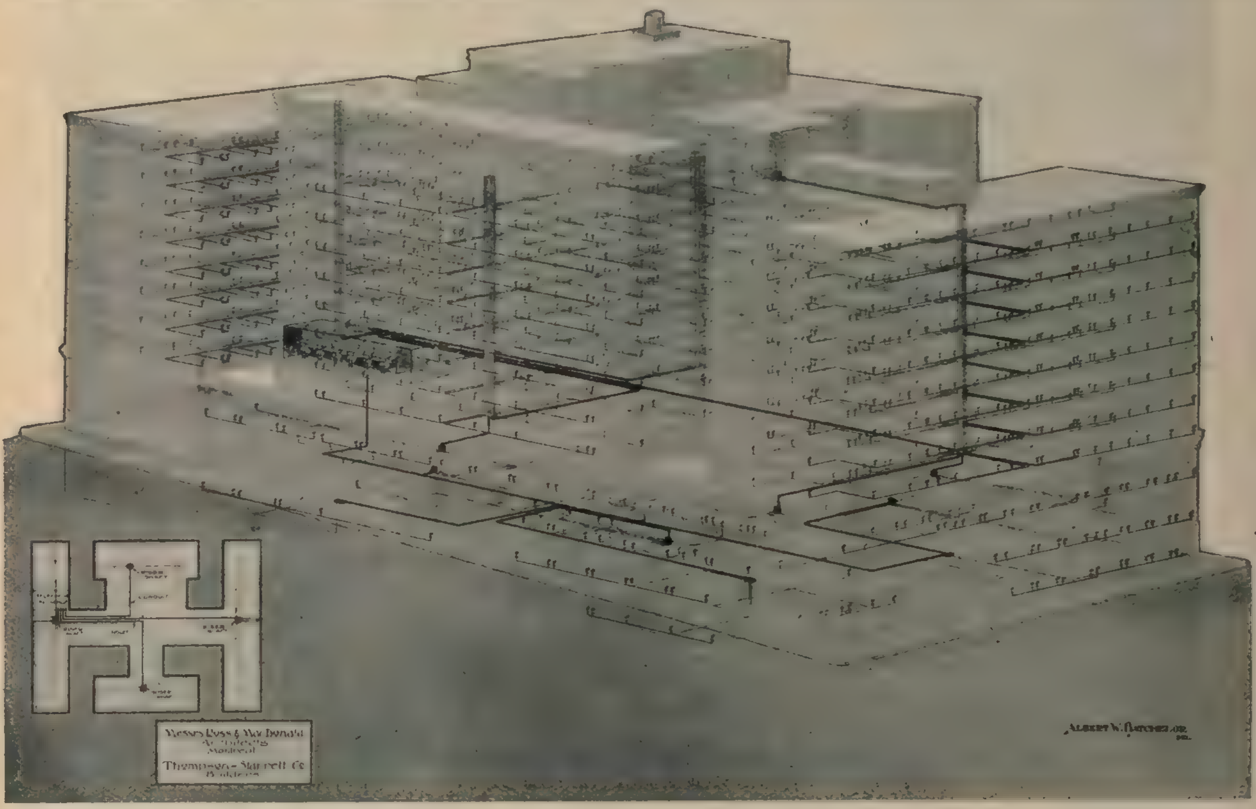
Each typical bedroom will have a ceiling light for general illumination, controlled by a local switch at the entrance to the room, three base plugs for local lighting and one telephone plug. Each bathroom will have a bracket light over the washbasin and cabinet, controlled by a local switch at the bathroom door, and a heater plug for heating appliances at the side of the washbasin.

The lighting in the main lobby, palm room, main dining-room, and ball and banquet rooms will be controlled by push buttons operating remote control switches. Carriage calls, controlled by attendants at the entrances, will be placed outside at the corners of the buildings.

All the conduit in general is concealed in the floor slab, pipe spaces and shafts being utilized for the main feeder risers from the basement to the top of the building. In concealing the conduit in the floor slab, all conduit and outlets were placed in the forms in time to cause no delay to other trades, and practically no changes were necessary after the concrete had been poured.

Quantities Involved

On each floor there are approximately six miles of conduit, fifteen miles of wire, fifteen hundred outlets for ceiling and bracket lights, base plugs, switches, telephones, vacuum cleaners, etc., making a total for the building of approximately the following—10 power distributing panels; 125 lighting distributing panels; 450,000 feet assorted sizes of conduit; 1,250,000 ft. assorted sizes of wire; 17,000 outlets; 135 motors, ranging from 1/8 to 40 h.p.; 70 fire alarm boxes; 65 fire alarm gongs; 35 electric clocks; 30 electric time stamps; and 107 watchman stations.



Translucent Perspective of the new Mount Royal Hotel, Montreal, showing telephone arrangements

In keeping with the general character of the building, all the electrical apparatus and supplies will be of the latest, best and most reliable manufacture, from the service entrance to the outlets, and include almost every conceivable electrical system adaptable for the convenience and comfort of the patrons of a building of this nature.

The Telephone System

The private branch switchboard to be installed is of the latest type and the largest size used for hotels and similar establishments. The type is known as the No. 604 and has capacity for some 2,000 local lines and 180 lines to the central office. It will be equipped initially to accommodate 1,200 local lines and 50 trunk lines, and will have 6 positions, with provision for an ultimate extension to 10 positions. The switchboard is of the lamp signal type and equipped with all the latest conveniences for hotel service.

All the wiring in the building will be brought into the terminal room and connected to the main distributing frame, which will have an equipment to terminate 2,200 lines, including 200 lines connected to the central office. In addition to the main distributing frame there will be a coil and relay rack made up in two sections.

The power equipment, which is housed in a separate room, consists of a mercury arc rectifier, with a suitable slate switchboard and a set of 11 Type E-7 cells in an oak cabinet. Alternating current of 110 volts will be supplied as the source of power and will be converted into direct current by the rectifier in order to charge the batteries.

The operators' rest room is to be located adjacent to the switchboard room and will be arranged to afford the greatest convenience to the operators. It is proposed to connect the switchboard with the information clerks in the office of the hotel by direct order wires.

The public telephone room will be located on the main floor, in the vicinity of the main lobby, and will be equipped with 18 standard folding door booths and a 2 position P. B. X. switchboard for the attendants, with a suitable enclosure. This public telephone room will be connected directly to the main distributing frame. All the stores in the building will also be connected to the main distributing frame adja-

Outstanding Features of the Mount Royal Hotel Summarized

General Plan

Size of lot is 230 ft. 6 inches by 310 ft. 6 inches; area 71,570 square feet; height of building 130 ft. to main roof. The ground floor is comprised of shops, cafeteria, grill room, barber shop and general toilet. The main floor includes main lobby, palm room, main dining room, cafe, main kitchen and offices. The mezzanine floor contains private dining room and offices. The first to eighth bedroom floors are made up of 1036 guests' rooms with 969 baths. The ballroom floor comprises ballroom, banquet room, convention hall, kitchen and helps' dormitory. The ballroom mezzanine floor is laid out for the accommodation of housekeepers and dormitory space.

Foundations

Consist of three hundred and eighteen caissons which go to rock with an average depth of twenty-one feet below the basement level.

Excavation

55,000 cubic yards of blue clay were removed. A large part of the lot contained piles from foundations of old buildings.

Structural Steel

4,500 tons of steel involved which was furnished and erected by the Dominion Bridge Company.

Ornamental Iron Stairs

There is a total of sixty-two flights of stairs, five of which, continue through the entire building.

Elevators

Total of thirteen elevators and two dumbwaiters of which seven are passenger elevators—one to be used for the office section of the building; three service elevators; two freight elevators; one automatic push-button control elevator and two automatic push-button control dumbwaiters.

Windows

The number of windows total 1578.

Arches

Constructed of reinforced cinder concrete. The total area involved is 707,442 square feet or approximately 12,000 cubic yards of concrete.

Brick Work and Cast Stone

The building is faced with Canadian Benedict stone to first bedroom floor, including the central section from the eighth floor to roof. From the first to the eighth bedroom floor, a light grey, wire cut face brick is used; all stone work being backed with brick and 2 inch hollow tile split furring; the face brick being backed with 8 inch hollow tile. There is involved about 50,000 cubic feet of cast stone; 850,000 face brick; 1,113,000 common and hollow brick; 120,000 square feet of hollow tile backing.

Partitions

Made up of hollow tile and gypsum block. There is involved approximately 1,223,000 square feet of partitions of which 555,000 square feet are gypsum block.

Plaster

The total number of square yards is 250,000 including 44,000 square yards of suspended ceiling.

Marble and Tile

The floors of the bathroom throughout are of ceramic tile with a wainscot of marble with cap and base. The barber shop and general toilet are laid out with a marble floor and marble wainscot. The floor border and base throughout the corridor will be of terrazzo.

Woodwork

All doors throughout the guest portion of the building are to be of mahogany; all trim to be of gum wood.

Finish Floor

Approximately 590,000 square feet involved.

cent to the telephone room, and by this means it will be possible to make changes with the greatest convenience.

Refrigeration and Ice Boxes

Refrigeration for the hotel will be supplied by an isolated refrigerating plant with approximately 75 tons per day capacity, and will comprise piping for brine circulating systems, a complete ice making plant and 62 brine cooled refrigerator boxes distributed throughout the building.

Laundry Equipment

A complete laundry is to be installed to handle all the work for guests and service of the hotel, and will include all the latest developments of modern practice. This equipment is being supplied by the Canadian Laundry Equipment Co.

Kitchen Equipment

Kitchen equipment will be provided complete with bake ovens for four complete kitchens—the main kitchens which will serve the main dining room; one to serve the grill and cafeteria on the ground floor; one to serve the banquet room on the ball room floor and one which helps the kitchen on the ground floor. Kitchen equipment is to be complete in every respect and includes 266 items of equipment for the four kitchens.

Temporary Power Plant

Power for construction purposes is practically all motor driven, there being about 700 h.p. of temporary equipment for construction purposes. This is supplied from the mains of the Montreal Light, Heat & Power Consolidated through transformers located on the stie. Power for temporary purposes is 3 phase, 500 volts. Temporary lighting is a.c. 115 volts. Power for the temporary operation of elevators during construction is supplied by a 100 k.w. motor generator set, the motor being 550 volts, 3 phase and the generator 230 volts d.c.

Roofing

The Carmichael Waterproofing Co. Limited, Toronto, are applying a ten-year bonded Barrett specification roof on the entire building. All sheet metal work in connection with the outside of the hotel building is to be of 16 oz. cold rolled copper. There will be approximately thirty tons used in connection with the company's work, which covers all cornices, skylights, balusters, flashings, ventilators, etc. There are approximately two thousand square feet of skylights.

The following firms in addition to those mentioned elsewhere, supplied materials or equipment: Pedlar People Ltd.; Deschambault Quarry Corp.; Inventions Ltd.; Mussens Ltd.

To be Completed in November

The work started in September 1921, and the time schedule contemplates completion on or before November 15th 1922. The number of men employed on actual building operations is 1,250 but this force will be increased later.

Ross & Macdonald, Montreal, are the architects, and all the mechanical and electrical engineering problems in connection with this work have been carried out through their engineering department, under the direction of Mr. W. J. Armstrong, engineer. The Thompson-Starrett Co. Limited, Montreal, are the general contractors.

Financing the Hotel

The financial end of the undertaking is being handled by the Toronto firm of W. A. McKenzie & Co. Ltd. The capitalization consists of $6,000,000 of 8 per cent. debentures convertible into 8 per cent. cumulative preferred stock on July 1st, 1923, at the option of the company; and $6,000,000 of common stock. The total authorized preferred stock issue is $7,000,000 and the capitalization is subject to a first mortgage bond issue of $4,000,000. W. A. McKenzie & Co. report that approximately 95 per cent. of the securities have been disposed of, chiefly in Canada.

The Mount Royal Hotel will be operated by the United Hotels Company of America, who own and operate a chain of eighteen hotels in Canada and the United States. These include the King Edward Hotel, Toronto; The Royal Connaught, Hamilton, and the new Prince Edward, Windsor, the largest and finest equipped hotels in the country. This gives the assurance that the new Mount Royal will have an excellent system of management by an organization with fifteen years' successful experience in hotel operation.

The character of the men constituting the board of directors of the Mount Royal Hotel Co. is a further guarantee of the good management of the hotel. The following are the directors:—Hon. C. P. Beaubien, K. C., director, Canadian Car & Foundry Co., Limited; Frank A. Dudley, president, United Hotels Co. of America; the Hon. W. J. Shaughnessy, K. C., director, Canadian Pacific Railway Co.; W. M. Birks, vice-president, Henry Birks & Sons, Limited, director, Molsons Bank; G. H. Duggan, president, Dominion Bridge Co., Limited, director, Royal Bank of Canada; Commander J. K. L. Ross, director, Canadian Pacific Railway Co., director, Laurentide Company, Limited; Ernest R. Decary, B.A., LL.B., vice-president, Title Guarantee & Trust Corp. of Canada; W. W. Butler, president, Canadian Car & Foundry Co., Limited; W. J. Cluff, president, National Electro Products, Limited; A. D. Mactier, vice-president, Canadian Pacific Railway Co.; Col. F. S. Meighen, C.M.G., president, Lake of the Woods Milling Co., Limited, director, Canadian Pacific Railway Co.; Hon. Smeaton White, president, The Gazette Printing Co., Limited, director, Montreal Trust Co.; Col. J. T. Loree,, D.S.M., gen. manager, The Deleware & Hudson Railway Company; Brig.-General J. Leslie Kincaid, D.S.O., president, Kincaid & Co., Inc., and W. A. Mackenzie, president, W. A. Mackenzie & Co., Limited.

Resolutions of Canadian Good Roads Assn.

Approval of the principle of provincial autonomy in roadbuilding; that selection of routes or roads to be improved be made with the objects of local service, eventual co-ordination of all roads within the province so that the completed system will form a comprehensive whole and that interprovincial roads may be made a part of such plan: that roads be built economically and of such sandard as may best suit traffic which they must bear, and that roads when improved shall be maintained.

The principle of federal aid was reaffirmed, "because improved roads are a great national asset and of great importance to Canada." This resolution embodies a clause which reads: "Any province at the expiration of the time limit set forth by the present Act respecting federal aid which may not have been able to take full advantage of the allotment for that particular province, owing to labor and financial conditions, shall be entitled to an extension of time, such extension not interfering with any future federal assistance."

List of Contractors Operating on the Mount Royal Hotel, Montreal

GENERAL CONTRACTORS

Thompson Starrett Company, Limited Montreal.

Sub-Contractors		Contract
Wallace Bell Company, Limited	Montreal	Well.
T. A. Morrison & Co.	"	Concrete & brick sand.
W. J. Barber & Co.	"	Main sewer.
Canadian Tube & Steel Products, Ltd.	"	Reinforcing steel.
Dominion Bridge Co. Ltd.	"	Structural steel.
Morrison Quarry Co.	"	Crushed stone.
Canadian Benedict Stone, Ltd.	"	Stone work.
Webster & Sons, Ltd.	"	Face brick.
Hyde Builders' Supply Co.	"	Face brick.
C. O'Donnell	"	Cinders.
Canada Cement Co. Ltd.	"	Canada portland cement.
A. Brabant	"	Unloading & hauling.
Anglin-Norcross Ltd.	"	Natural granite.
Canadian Fairbanks-Morse Co. Ltd.	"	Scales.
A. A. Giddings & Co. Ltd.	"	Transformers.
Western Supply & Mfg. Co. Ltd.	Winnipeg	Ornamental iron.
E. E. Davis Co. Ltd.	Montreal	Arches, fill, finish, sidewalks.
Otis-Fensom Elevator Co. Ltd.	"	Elevators.
Canadian Allis-Chalmers Co. Ltd.	"	Ornamental iron.
Alex. Bremner, Ltd.	"	Patent scaffold.
The Thos. J. Dyer Co. Ltd.	"	Plumbing.
Traversy Ltd.	"	Wood window frames & sash.
Stinson-Reeb Builders' Supply Co. Ltd.	"	Mason's hydrated lime.
Robb Engineering Works, Ltd.	"	Water tube boilers.
Taylor Stoker Co. Ltd.	"	Power dump underfeed stokers.
Metal Shingle & Siding Co. Ltd.	"	Bronze, kalamein doors, etc.
Canadian Comstock Co. Ltd.	"	Conduit wiring, etc.
The Garth Company	"	Heating, ventilating, power piping.
Canadian Cutler Mail Chute Co. Ltd.	"	Mail chute.
National Fire Proofing Co. of Canada, Ltd.	Toronto	Backup tile.
J. & J. Taylor, Ltd.	Montreal	Vault doors.
Carmicheal Waterproofing Co. Ltd.	Toronto	Roofing & sheet metal.
Crane Ltd.	Montreal	Plumbing fixtures & trimmings.
C. H. Johnson & Sons, Ltd.	"	Screens.
Minogues Cartage Co.	"	Hauling.
Ebsary Gypsum Co. Ltd.	"	Gypsum hollow partition blocks.
Window Strip & Supply Co. Ltd.	"	Weather strips.
Taylor Forbes Co. Ltd.	"	Three ejector plants.
National Brick Co. Laprairie, Ltd.	"	Common plastic brick .
J. Martinelli	"	Hauling.
Pilkington Bros. Ltd.	"	Glass & glazing.
Interprovincial Plastering Co.	Windsor	Plastering.
Canadian Ingersoll-Rand Co. Ltd.	Montreal	Compressors.
Italian Mosaic & Marble Co. Ltd.	Toronto	Tile.
Wallace Sand Stone Quarries, Ltd.	Montreal	Interior marble.
De Paoli & Co.	New York	Terrazzo.
Jas. Elgar Inc.	" "	Wood trim.
Canadian Laundry Machinery Co. Ltd.	Toronto	Laundry machinery.
Montreal Lumber Co. Ltd.	Montreal	Lumber.
Canadian Link Belt Co. Ltd.	Toronto	Conveyor system
Canadian Westinghouse Co. Ltd.	"	Motors.
McFarlane-Douglas Co. Ltd.	Ottawa	Hollow metal & kalamein.
Meldrum Bros. Ltd.	Montreal	Carting.
Kendall Bros.	"	Carting.
Alex. Craig, Ltd.	"	Painting.
Northern Electric Co. Ltd.	"	Electric supplies.
Laurie & Lamb	"	Engines.
Wm. Rutherford & Sons, Co. Ltd.	"	Pipe covering.
Upper Kittanning Brick Co. Ltd.	Jersey City	Brick.
Canadian Jewett Refrigerator Co. Ltd.	Bridgeburg, Ont.	Refrigerators.
Lloyds Sales Ltd.	Montreal	Lighting fixtures.
Master Builders' Co.	"	Dust preventive.
Gurney-Massey Co. Ltd.	"	Kitchen equipment.
DuParquet, Huot & Moneuse Co. of Canada,	New York	Kitchen equipment.
Mander & Lucas	Montreal	Boiler brick setting.
Trussed Concrete Steel Co. of Canada, Ltd.	Toronto	Lorib metal lath, channels & angles for plastering, steel sash.
Devoe Electric Switch Co.	Montreal	Lighting and power panels.
Frick Ice Machinery Co.		Refrigeration machinery.

DEVOE

Lighting and Power Panels

for the

New Mount Royal Hotel---Montreal

were supplied by the

DEVOE ELECTRIC SWITCH COMPANY

MONTREAL and TORONTO

SPECIALISTS
in Fine Interior Woodwork

We will supply and erect complete woodwork in any part of Canada

Board Room of The Canadian Consolidated Rubber Co. Limited.

A copy of our "Standard Details" will be sent to any Architect on request

All Wood Window Frames and Sashes for the Mount Royal Hotel were made by us

TRAVERSY LIMITED

Manufacturers of the better class of Woodwork

Head Office, 136 Papineau Ave. MONTREAL

Mill, 880 De L'Epee Avenue, Outremont

Permanence

—guaranteed by the manufacturers

WE are prepared to give a ten year guarantee on houses built with Gypsum Block to our own specifications. Many such houses have already been constructed in various parts of the country.

Gypsum Blocks are rapidly handled, can be readily cut with a saw and fitted and are sufficiently strong to carry the designed load of any house. When finished with stucco such a house is of unusual beauty.

Gypsum Board

Protects the interior of your house. Do not have flimsy wood lath in the houses you are building. Use the modern Gypsum Board and Plaster. It does not burn, warp, shrink, or crack and is absolutely fireproof besides being just as cheap to apply as wood lath.

If you will write us we shall be pleased to forward a booklet descriptive of all our materials. We have splendid plans drawn up by one of the leading architects which incorporate Gypsum Block in the exterior walls and Gypsum Board on the interior and would be pleased to submit them to any builder who is interested.

The Ontario Gypsum Co., Ltd.
Head Office - Paris, Ont.
Toronto Offices: 106 Don Esplanade Montreal 14 St. John Street
Factories: Caledonia, Ont., Lythmore, Ont.

Ross & MacDonald
Architects

Thompson-Starrett & Co.
Contractors

MOUNT ROYAL HOTEL

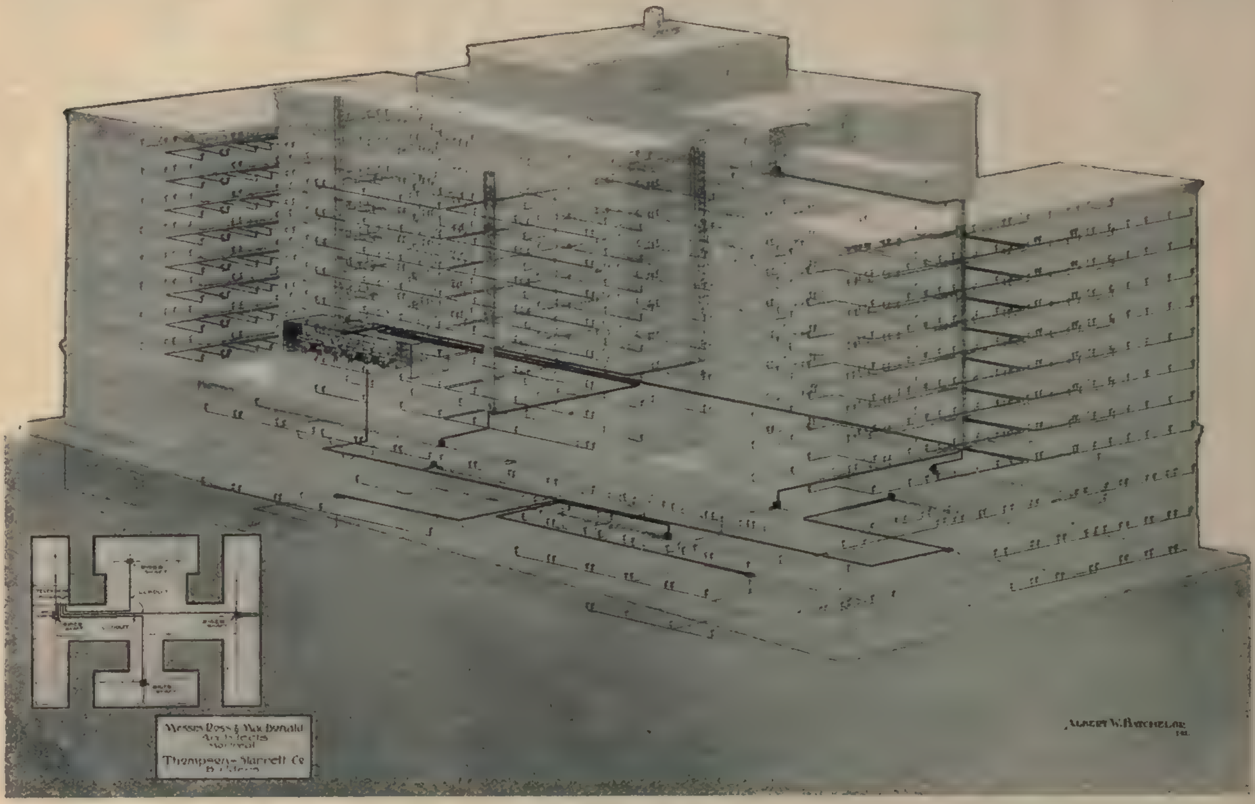
Montreal, Quebec

For this magnificent hotel now being constructed "CROWN" METAL covered Doors, Trim, etc., and "CROWN" Hollow Metal Doors, Trim, etc., have been selected.

McFarlane-Douglas Company, Ltd.

Manufacturers and Contractors

Ottawa Ontario



Telephone Conduit System Mount Royal Hotel

The Entire Electrical System

of the Mount Royal Hotel was Installed

by the

CANADIAN COMSTOCK COMPANY, LIMITED

New Birks Building, - - - Montreal

COMSTOCK COMPANY

Their recent contracts include:

Canada Cement Building	Montreal
New Building for Crane Limited	Montreal
New Building for the Herald Press	Montreal
New Building for The Liquor Commission of Quebec	Montreal
McDonald Tobacco Factory	Montreal
National Breweries	Montreal
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New Mills for the International Paper Comapany	Three Rivers
Wayagamack Pulp & Paper Company	Three Rivers
St. Maurice Paper Company	Three Rivers
Davie Shipbuilding & Repair Company	Quebec
New Union Station	Toronto
Dunlop Tire & Rubber Goods Company	Toronto
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(See editorial article in this issue of "Contract Record")

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Montreal

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S. G. Davenport, Architect

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The Mount Royal Hotel, Montreal, the General Motors building and First National Bank Building of Detroit, Michigan, represent three of our recent floor jobs worthy of note.

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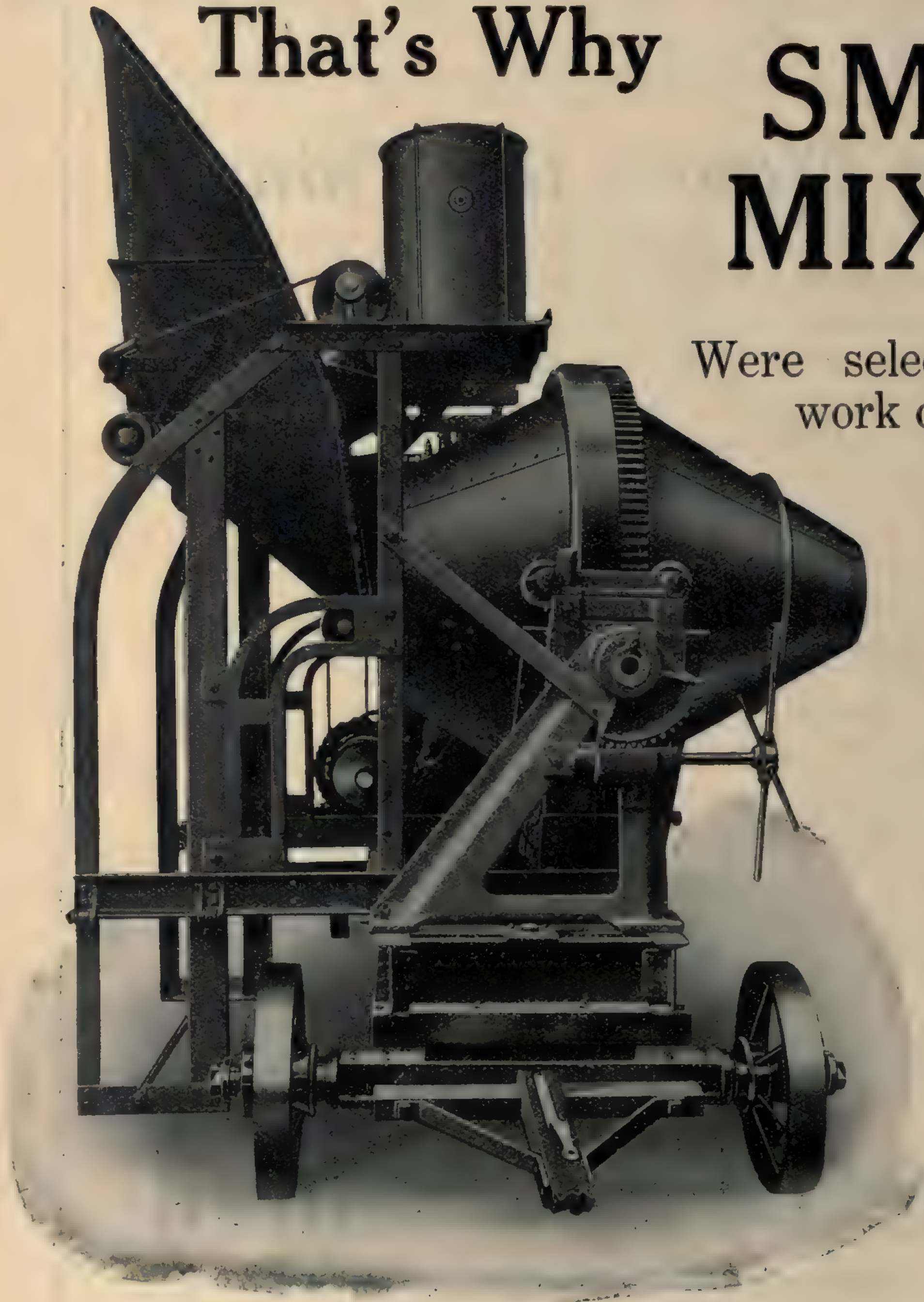

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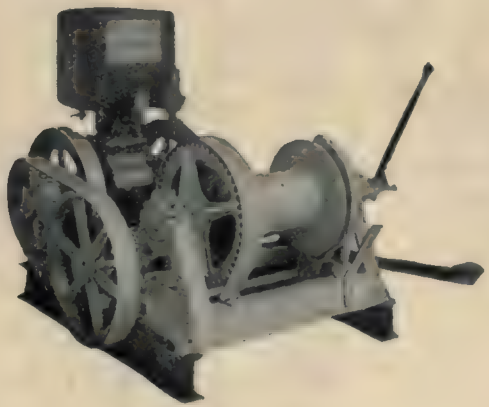

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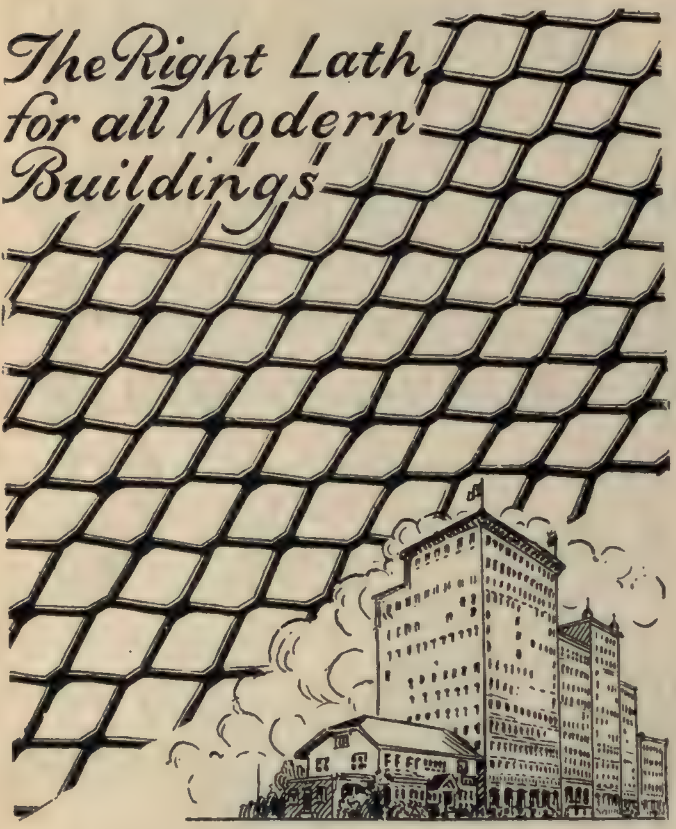
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is another Pedlar Product which is extensively used in the construction of durable partition walls in the Mount Royal Hotel. This material is highly popular with all registered architects who realize the importance of giving permanent protection to plastered corners. It is punched for nailing and can be curved to fit any arch.

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Mount Royal Hotel
Montreal

Architects—Ross & MacDonald
Contractors—Thompson-Starrett Co., Ltd.

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Is being used to back up the face brick work of all the exterior walls of the Mount Royal Hotel as well as for the column covering and principal interior partitions.

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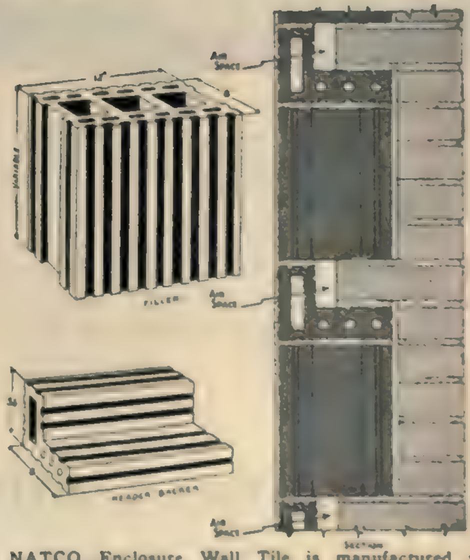

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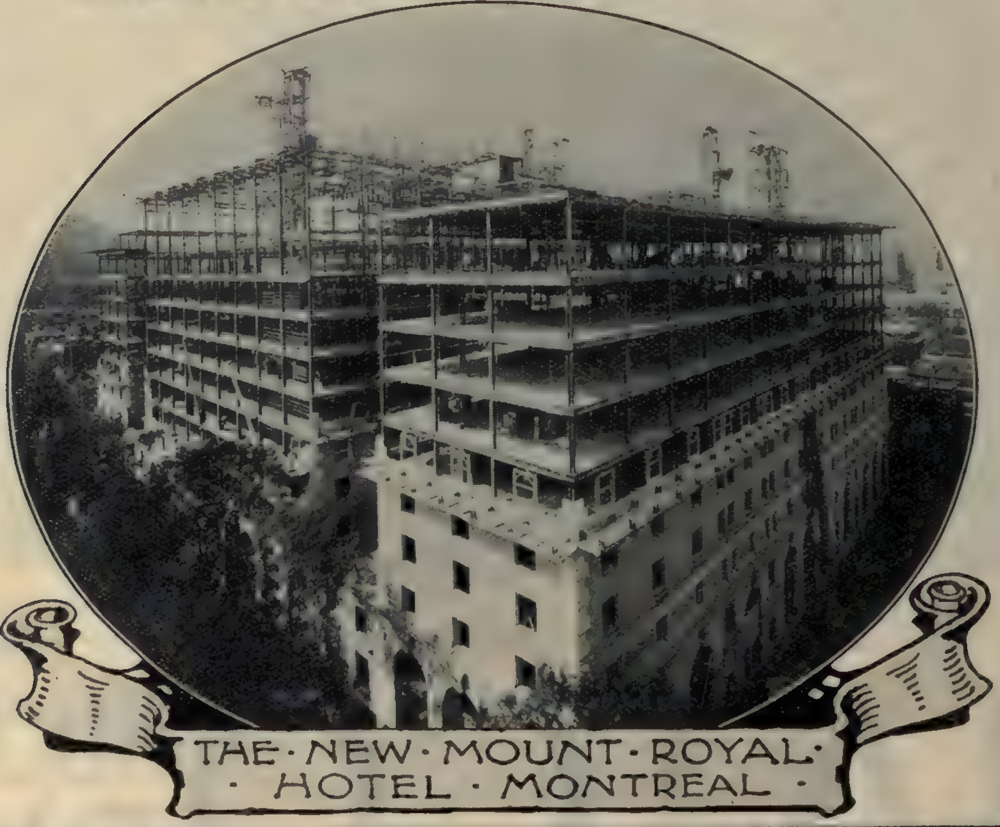
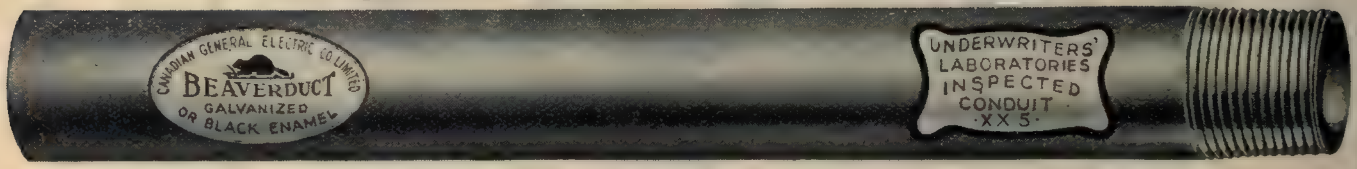


THE · NEW · MOUNT · ROYAL · HOTEL · MONTREAL ·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Roofing and Sheet Metal Work
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By our underwriting of the 8% Convertible Debentures of The Mount Royal Hotel Company, Limited, we have extended the field opened up by us in selling the securities of the King Edward Construction Company, Limited.

Before we underwrote the Mount Royal Convertible Debentures, you may be sure we thoroughly investigated every phase of the enterprise, and, particularly, those matters pertaining to the security and interest and dividend-earning powers of the hotel and its management. We are convinced, so far as it lies within human power to form convictions, that every investor's money in this enterprise will be safe.

We know positively that no other City in Canada has one-quarter of the tourist and commercial traffic passing through it. Montreal is Canada's greatest seaport; it is a transcontinental terminal and the pivotal attraction and distributing point for tourist traffic, conventions and similar sources of revenue.

The Directorate of "The Mount Royal" is strong. It comprises fifteen of the most successful business men in Canada. So able a group of men would never invest in, or associate themselves with, a company the success of which might be in doubt.

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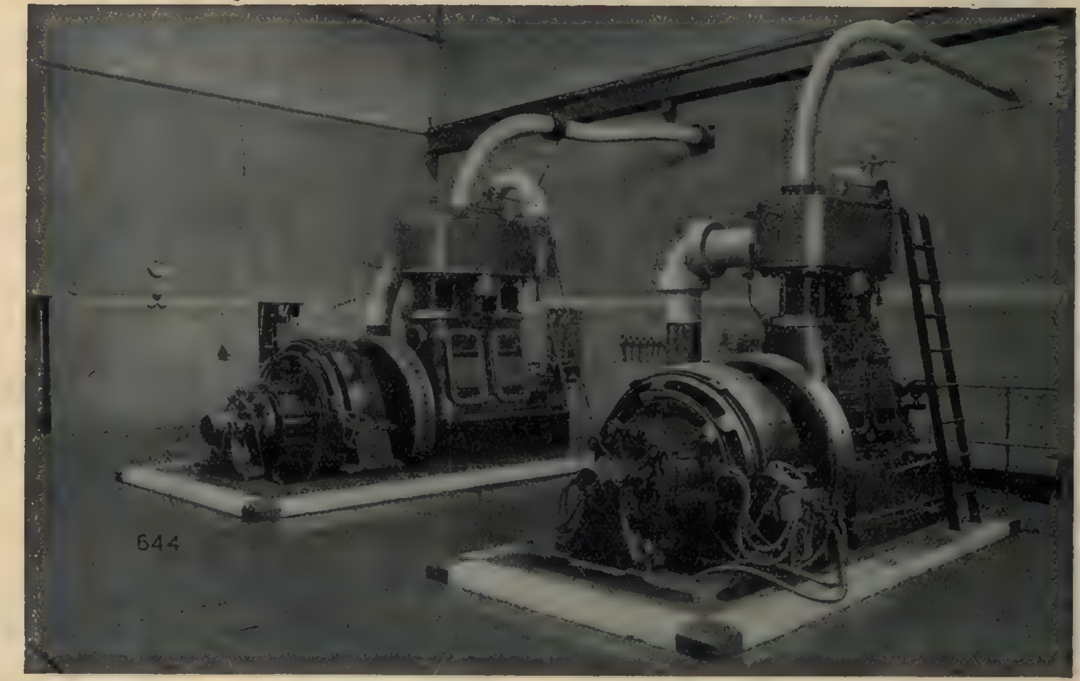

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MOUNT ROYAL HOTEL

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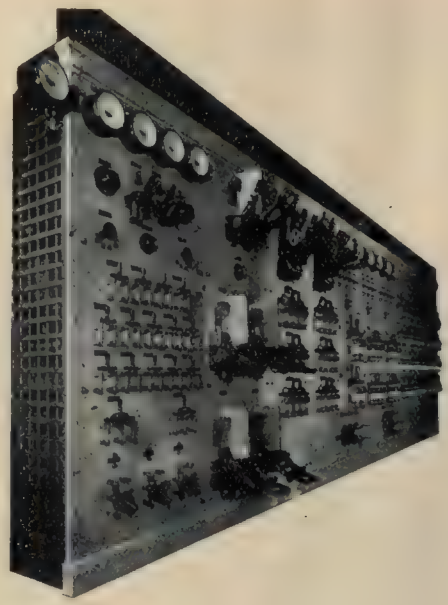

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CONSTRUCTIONAL ACTIVITY

Period of June 21 to June 27, 1922

Dominion Wide Service Exclusive to "Contract Record & Engineering Review"

Waterworks, Sewerage and Roadways

Elma Twp., Ont.
Geo. Lochead, Atwood, Ont., clerk Elma Twp. Council, has plans and will receive tenders until July 8th for construction of Boyle drain to cost $81,114. Marked cheque for 10% of tender required.

Galt, Ont.
Sewer costing $11,528 is being constructed on Blair Rd. and Samuelson St. by City, work by day labor. J. D. Black, Engr.

Kamloops, B. C.
An appropriation of $68,000 has been made by Prov. Gov't. for work on North Thompson Road and opening of branch feeders to various settlements. G. B. Whitehead, Dist. Engr.

Kirkland Lake, Ont.
Teck Twp. Council plan construction of water system costing $60,000 at Kirkland Lake and Swastika.

L'Assomption, Que.
J. L. Boulanger, Deputy Min. Prov. Gov't Roads Dep't., Quebec, will receive tenders until July 11th for 11,687' of gravel road.

Maskinonge, Que.
Prov. Gov't. Roads Dep't. contemplate rebuilding 1 mile of concrete road at cost of $15,000.

Montreal, Que.
J. L. Boulanger, Deputy Min. Prov. Gov't. Roads Dep't., will receive tenders until July 11th for resurfacing road in St. Jerusalem, St. Hermas, St. Scholastique, St. Augustin and St. Eustache, on Montreal-Ottawa Highway.

Ottawa, Ont.
City Council will resurface asphalt pavement on Metcalfe St. A. F. Macallum, Commr. of Works.

Rougemont, Que.
Town Council will construct aqueduct at cost of $30,000.

St. Catharines, Ont.
City Council plan construction of sidewalks and sewers on St. Paul, Merigold, Moote and Vine Sts. W. P. Near, Engr.

Sherbrooke, Que.
J. L. Boulanger, Deputy Min. Prov. Gov't. Roads Dep't., Parliament Bldgs., Quebec, will receive tenders until July 8th for gravelling on Beauceville-Sherbrooke Highway. Plans with G. Henry, Engr., Parliament Bldgs., Quebec.

Three Rivers, Que.
Plans are being prepared for aqueduct to cost $40,000 on Notre Dame St. for City.

Plans are being prepared for sewer to cost $32,000 on Notre Dame St. for City. Chs. Gelinas, Engr.

City Council will construct sidewalks at cost of $12,000.

Vernon, B. C.
Tenders will be received by Pub. Works Dep't., Prov. Gov't., Victoria, no closing date set, for approximately 5 miles of roadwork. Plans with Dep't.

Wellland, Ont.
Plans will be prepared for resurfacing pavement at cost of $13,000 on Burgar St. for City. W. E. Forester, clerk.

CONTRACTS AWARDED

Belleville, Ont.
General contract for construction of sanitary sewers and laterals for City is awarded to W. H. Patterson, 211 Dufferin Ave.

Birch Cliff, Ont.
Scarboro Twp. Council awarded following contracts for construction of concrete sidewalks: 5 streets, $10,000, Grant Contracting Co., 50 Front St. E., Toronto; 1 street, $8,000, W. B. Hughes, 53 Victoria Park Ave.; 2 streets, J. A. Johnson, 35 Burgess Ave. C. E. Fraser, Engr., Birch Cliff.

Goudreau, Ont.
General contract for construction of gravel road costing $25,000 for Dep't. Pub. Highways, Prov. Gov't., is awarded to Victor Lines ,153 Leo Ave., Sault Ste. Marie.

Ottawa, Ont.
City Council awarded contracts at $12,240 for asphalt pavement on Sherbrooke St., and $12,000 for asphalt pavement on Breezehill Ave., to O'Leary's Ltd., Banque Nationale Bldg.

Revelstoke, B. C.
Angus McDonald, 436 Prior St., Vancouver, is awarded general contract for construction of road costing $38,000 for Prov. Gov't.

Shelburne, Ont.
Contract for road grading in Mona and Melancthon Twps. for Prov. Gov't. is awarded to The Cambers-McCaffery Construction Co. Ltd., Excelsior Life Bldg., Toronto.

Toronto, Ont.
Contract at $34,927 for construction of sewer on Victoria St. for City is awarded to W. E. Taylor, 22 Falcon St.

Vancouver, B. C.
General contract for roadwork costing $164,000 for City is awarded to Western Construction & Paving Co., 207 Hastings St. W. City Engr. Fellowes, City Hall.

City Council awarded contract for concrete paving costing $26,000 to Columbia Bitulithic Ltd., Pender and Homer Sts. City Engr. Fellowes, City Hall.

Walkerville, Ont.
Merlo, Merlo & Ray Ltd. have general contract for construction of concrete pavements for Council. H. W. Patterson, Engr., Imperial Bldg.

Railroads, Bridges and Wharves

Grosse Isle, Que.
R. C. Desrochers, secy. Pub. Works Dep't., Dom. Gov't., Ottawa, will receive tenders until July 6th for extension to wharf. Plans with Dep't., Ottawa, and at offices of Dist. Engrs., Post Office Bldg., Quebec, Shaughnessy Bldg., Montreal, and Post Office, Montmagny. Accepted cheque for 10% of tender required.

Port Stanley, Ont.
Construction of bridge is contemplated by Elgin County Council. Jas. S. Bell, Engr., Court House, St. Thomas.

Prince Rupert, B. C.
Plans are being prepared for bridge over Hay's Creek for City. F. T. Whittaker, City Engr., Prince Rupert.

St. Joseph de Ham-Sud, Que.
O. Lamoureux, secy., has plans and will receive tenders until July 2nd for construction of reinforced concrete bridge for Town. Plans with I. E. Vallee, Engr., Parliament Bldgs., Quebec.

St. Maurice, Que.
Town Council contemplate rebuilding bridge which was destroyed by a recent flood. Rodrigue Elie, secy.

Thetford Mines, Que.
Asbestos Corp. of Canada, Thetford Mines, will rebuild bridge at cost of $15,000. C. V. Smith, Engr.

CONTRACTS AWARDED

Bathurst, N. B.
General contract for concrete substructures for bridge for Prov. Gov't., is awarded to Connolly Bros.

Malahide Twp., Ont.
Contracts for steel work and concrete work for bridge costing $100,000 for Elgin County Council are awarded to Dominion Bridge Co. Ltd., Dominion Station, Lachine, Que., and C. O. Laidlaw, 1220 Victoria Ave., Windsor, Ont. Mr Bell, Engr., Court House, St. Thomas, Ont.

St. Antoine de Tilly, Que.
General contract for construction of bridge for Town Council is awarded to Boucher, Beauder & Aubin, St. Antoine de Tilly.

Public Buildings, Churches and Schools

Belleville, Ont.
Plans will be prepared for boiler room to cost $25,000 for Belleville General Hospital. Miss Millard, secy.-treas.

Bridgeburg, Ont.
C. M. Borter, architect, 102 Main St., Niagara Falls, has plans and will receive tenders until July 3rd for erection of hall to cost $30,000 for Town Council.

Crowland Twp., Ont.
L. M. Matthews, 545 Main St. S., Welland, secy. School Bd. S. S. No. 3, Crowland Twp., has plans and will receive tenders until July 5th for erection of school to cost $32,000. Plans also with MacLean Building Reports Ltd., 345

Adelaide W., Toronto. Norman A. Kearns, architect, Temple Bldg., Welland.

Edmonton, Alta.
Erection of hospital at cost of $100,000 is contemplated by Dom. Gov't., Dep't. Pub. Works.

Grantham Twp., Ont.
W. M. Wilson, architect, 15 Queen St., St. Catharines, has plans and will receive tenders until July 12th for erection of school for S. S. No. 2.

Hamilton, Ont.
Centenary Methodist Church Congregation plan alterations to church to cost $100,000. Rev. Dr. Rich. Whiting, Pastor.

Harewood, B. C.
Plans are being prepared for addition to school to cost $10,500.

Kirkland Lake, Ont.
Erection of a community hall is contemplated by Town Council. Mr. Campbell, clerk.

L'Abord a Plouffe, Que.
School Bd. will erect a school. J. Caron, architect, 21 St. Joseph St., Three Rivers.

London, Ont.
Rev. J. A. Agnew, 87 Windsor Ave., has plans and will receive tenders, no closing date set, for erection of church to cost $10,000.

Mimico, Ont.
Erection of Sunday School at cost of $30,000 is contemplated by Methodist Church Congregation. W. H. Rumbell, Chrm. of Com.

Moncton, N. B.
Church is being erected at corner St. George and Highfield Sts. by West End Baptist Church Congregation, work by day labor. Leslie R. Fairn, architect, Aylesford, N. S.

Montreal, Que.
Erection of church is planned by Church of The Redeemer Congregation. Philip J. Turner, architect, 241 Beaver Hall Hill.

Mount Hamilton, Ont.
J. A. Armes, architect, 67 Charles St., Hamilton, has plans and will receive tenders until July 7th for erection of school to cost $100,000 for School Bd. S. S. No. 3.

Niagara Falls, Ont.
Plans are prepared for Sunday School to cost $40,000 for Lundy's Lane Methodist Church Congregation. C. M. Borter, architect, 102 Main St.

St. Eloi, Que.
Erection of school is contemplated by School Bd. J. April, secy.

St. Jean de Dieu, Que.
Tenders will be called shortly for erection of school to cost $30,000 for School Cmsn. F. Rioux, secy.

St. Tite, Que.
Plans are being prepared for school for School Bd. E. L. Denoncourt, architect, 136 Notre Dame St., Three Rivers.

St. Valerien, Que.
J. O. Turgeon, architect, 103 St. Francois Xavier St., Montreal, is preparing plans for church to cost $100,000 for Parish.

Tomahawk, Alta.
Plans are being prepared for school for Limeson S. D. No. 4083. W. F. Combs, secy.-treas.

Toronto, Ont.
J. P. Hynes, architect, 73 King W., is preparing plans for dormitory bldg. to cost $200,000 for St. Josephs Convent, St. Albans Street.

Tregarva, Sask.
Erection of school is contemplated by Boggy Creek S.D. Jas. Dougans, secy.-treas.

Unity, Sask.
Tenders will be called for erection of hospital to cost $60,000 for Union Hospital Bd. R. M. Thompson, architect, Bank of Nova Scotia Bldg., Saskatoon.

CONTRACTS AWARDED

Belisles Mills, Que.
J. Raymond, St. Agathe, Que., has roofing contract for convent costing $24,000 for Soeurs St. Anne.

Burlington, Ont.
General contract for erection of Sunday School costing $22,000 for St. Lukes Anglican Church Congregation, is awarded to Canadian Engineering & Constuction Co., Home Bank Bldg., Hamilton; additional contracts are: Steel, Hamilton Bridge Works Co. Ltd., Bay St. N., Hamilton; plumbing and heating, Goodram Bros., 248 King W., Hamilton; electrical, Culley & Breay, 35 King W., Hamilton. Husband & Robertson, architects, Merchants Bank Bldg., Hamilton.

Burnaby, B. C.
Contracts for sheet metal, ventilating, drainage and heating for high school costing $30,034 for School Bd. are awarded to James & McClugan, Begbie and Front Sts., New Westminster. McCarter & Nairne, architects, Northwest Bldg., Vancouver.

Deseronto, Ont.
Wm. H. Harvey has general contract for remodelling public school at cost of $12,000 for School Bd.

Ekfrid Twp., Ont.
General contract for erection of continuation school for Trustees S.S. Nos. 4, 6 and 13, is awarded to D. J. McEachern & Son, Alvinston, Ont.

Essondale, B. C.
Electrical contract at $20,000 for addition to Mental Hospital costing $573,800 for Prov. Gov't., is awarded to C. C. Carter, 739 Hastings St. W., Vancouver.

Ford City, Ont.
General contract for erection of school to cost $100,000 for Pub. School Bd. is awarded to Proste, Forde & Westell, 3 Ouellette Ave., Windsor. A. H. McPhail, architect, McGregor Bldg., Windsor.

Kitchener, Ont.
Harold C. Kress, 95 College St., has electrical contract for parish hall costing $30,000 for St. Peters Lutheran Church Congregation. W. H. E. Schmalz, architect, 228 Frederick St.

Moncton, N. B.
Plumbing, heating and electrical contracts for school costing $80,000 for R.C. School Cmsn. are awarded to J. W. McCarthy, 202 St. George St. R. A. Frechette, architect, 30 Bonnacord Street.

Montmagny, Que.
Contract at $43,800 for cut stone for alterations to church costing $200,000 is placed with Naud & Darveau, St. Marc, Que. Contract at $6,000 for granite is awarded to Arsene Gosselin, Beauceville. Pierre Levesque, architect, 115 St. John Street, Quebec.

Montreal, Que.
General contract for erection of addition to Morin School costing $63,850 for Catholic School Cmsn., North Dist., 2060 St. Denis St., is placed with Alfred Filion & Freres, 2419 St. Denis St. J. O. Turgeon, architect, 55 St. Francois Xavier Street.

Additional contracts for school costing $38,000 for Protestant School Cmsn., 36 Belmont St., are: Steel, Dominion Bridge Co. Ltd., Dominion Station, Lachine; plumbing, Peattie Bros., City Councillors St.; millwork, Jas. Davidson's Sons, Wellington St., Ottawa; roofing, Campbell Gilday & Co. Ltd., 793 St. Paul St. A. P. Darbyson, architect, 228 Madison Ave.

Additional contracts for church costing $50,000 for Fairmount Presbyterian Church Congregation, are: Roofing, Richardson Simard & Co., 745 Clarke St.; electrical, J. A. Anderson & Co., 205 Mansfield St.; plumbing and heating, Hickey & Aubut, 93 Dominion St.; plastering, A. T. Clarke, 745 St. Catherine W.; tile, Smith Marble & Construction Co., 145 Van Horne Ave.; millwork, Wm. Rutherford & Sons Ltd., 425 Atwater Ave.; hardware, Durand Hardware Co., 370 St. James St. MacVicar & Heriot, architects, 628 Union Ave.

Graham & Windsor, 745 St. Catherine St. W., have general contract for erection of school costing $21,483 for Protestant School Cmsn., 36 Belmont St. Additional contracts are: Plumbing and heating, Jno. Bailey, 563 Joliette St.; steel, Phoenix Bridge & Iron Works Ltd., 83 Colborne St.; millwork, Traversy Ltd., 136 Papineau Ave.; electrical, J. A. Anderson, 205 Mansfield St. A. P. Darbyson, architect, 228 Madison Ave.

Ottawa, Ont.
General contract for erection of hall costing $50,000 for St. Jean Baptiste R. C. Congregation is awarded to Poirier & Son, 193 Cathcart St. J. A. Larue, architect, 1026 Fairmount St. W., Montreal.

Additional contracts for church costing $46,000 for St. Lukes Anglican Church Congregation, are: Masonry, Mr. Patterson, c/o general contractors, Cooper & MacDonald, McLeod St.; roofing and galv. iron, Sanderson & Son, McLeod St.; plumbing and heating, Erskine & Smith, Nicholas St.; plastering, Murphy & Morrow, Royal Bank Bldg.; painting, Mr. Bassett, Westboro. Colin Drewitt, architect, 341 Riverdale Ave.

Powell River, B. C.
Thomas Carson, 970-8th Ave. W., Vancouver, has general contract for erection of addition to school for Powell River School Bd.

St. Anne des Monts, Que.
General contract for erection of church costing $160,000 for Les Syndics, St. Anne des Monts, is awarded to Jos. Collins, Riviere du Loup, Que. Mr. Raymond, architect, Quebec.

Saltfleet Twp., Ont.
General contract for erection of addition to school for S.S. No. 2, is awarded to Stuart Bros., 3 Hyde Park Ave., Hamilton. McPhie & Kelly, architects, Bank of Hamilton Bldg., Hamilton.

Sherbrooke, Que.
General contract for erection of school costing $66,000 for School Bd. is placed

with A. Dion, 71 Brooks St. Contract for reinforced steel is placed with United States Steel Products Co., 224 St. James St., Montreal. J. W. Gregoire, architect, 16 Wellington St., Sherbrooke.

Stayner, Ont.
Steel contract for school costing $57,500 for Bd. of Education is placed with Reid & Brown Ltd., 63 Esplanade E., Toronto. Contract for Natco Wall Tile is awarded to National Fireproofing Co. of Canada Ltd., Dominion Bank Bldg., Toronto. Smith & Wright, architects, 2945 Dundas W., Toronto.

Sudbury, Ont
General contract for erection of parish hall costing $17,500 for St. Ann's Church Congregation is awarded to Fred Levesque, Young St. Electrical and plastering contracts are awarded to Grant & Hiscock and J. H. Chenard. J. B. Laberge, architect.

Thornhill, Ont.
Additional contracts for school costing $33,000 for Markham & Vaughan Twps. Union S.S. No. 1, are: Stone, Geo. Oakley, 278 Booth Ave., Toronto; steel, Toronto Steel Construction Co., 95 King E., Toronto; roofing, Walter Davis & Co., 1433 Yonge St., Toronto; electrical, Matson & Co., Aurora; plumbing and heating, A. C. Henderson, Thornhill; plastering, John Miller, Unionville; painting, J. H. Smith, Willowdale. James, Proctor & Redfern Ltd., architects, 36 Toronto St., Toronto.

Thurlow Twp., Ont.
Thos. Manley & Sons, 65 St. Charles St., Belleville, have general contract for erection of school costing $30,000 for S.S. No. 5, Thurlow Twp. Plumbing and heating contracts are placed with Howe & Hagerman, 191 Front St., Belleville.

Toronto, Ont.
Heating and painting contracts for church and rectory costing $125,000 for Parish of St. Vincent de Paul, Roncesvalles Ave., are awarded to T. E. Regan, 40 Thome Cres., and A. Richard, 403 Spadina Ave. J. M. Cowan, architect, 3 Carlton Street.

Westboro, Ont.
Taylor & Lackey, 90 Powell Ave., Ottawa, have general contract for erection of collegiate costing $50,000 for Nepean Collegiate Institute. Richards & Abra, architects, 126 Sparks Street, Ottawa.

Whitby, Ont.
Contracts for remodelling school at cost of $16,780 for Bd. of Education, are: Masonry, steel and plastering, R. M. Deverell; carpentry and roofing, J. & J. Scott; electrical, plumbing and heating, F. Landon; painting, C. A. Bradley.

Business Buildings and Industrial Plants

Acton, Ont.
Business block costing $10,000 is being erected by J. R. Leishman, Bealton, via Villa Nova P. O.

Digby, N. S.
Plans are being prepared for bldg., to cost $15,000 for Royal Bank of Canada.

Hamilton, Ont.
Plans are being prepared for renovating theatre for Loews Theatres Ltd., King E.

Kirkland Lake, Ont.
Erection of hotel is contemplated by The Northern Ontario Hotel Co. Ltd.

Kitchener, Ont.
J. Waller & Sons, Gaukel St., has plans and will receive tenders until July 5th for erection of factory to cost $25,000. J. Knechtel, architect, Courtland St. W.

Lindsay, Ont.
Plans are being prepared for branch bank for Royal Bank of Canada.

Montreal, Que.
P. L. W. Dupre, architect, 20 St. James St., is preparing plans for store for Nap. Gingras.

Hotel will be erected at corner Ontario and Papineau for Mrs. Duhamel, 953 Ontario St. E. A. E. Doucet, architect, 195 St. Catherine St. E.

Bruneau Currie & Co. Ltd., 14 Place Youville, will erect a warehouse and grain elevator at cost of $60,000. W. B. McLean, architect, 999 Christophe Colomb St.

Palmerston, Ont.
I. X. L. Mfg. Co., will rebuild factory which was destroyed by a recent fire.

Pembroke, Ont.
B. Biggs is erecting a store at cost of $10,000, work by day labor.

St. Agathe, Que.
Plans are being prepared for erection of hotel for Z. Raymond. Bigonesse & Bigonesse, architects, 10 Cathcart St., Montreal.

Toronto, Ont.
C. F. Till, 19 Grassmere Rd., is erecting 2 stores and apts., at cost of $10,000 each.

Reg. A. Everett, 1659 Dufferin St., will build an arcade consisting of 14 small stores and 2 apts.

W. Worthington, 555 Markham St., will erect 2 stores and apts. at cost of $25,000.

Contracts for refrigeration system and show cases and fixtures for alterations to bldg.for cafeteria costing $10,000 for Pure Food Co., 141 Yonge St., are awarded to John Hillock & Co., 154 George St., and Jones Bros., 31 Adelaide W.

Welland, Ont.
Alfred Pellitt, John St., has general contract for erection of business block costing $21,000 for A. E. Atkins, Main and Burgar Sts. N. A. Kearns, architect, Temple Bldg.

Windsor, Ont.
Nichols, Shepherd & Colthurst, architects, 15 Sandwich St., have plans and will receive tenders until July 5th for erection of store to cost $15,000.

CONTRACTS AWARDED

Brockville, Ont.
Additional contracts for rolling mill for E. F. Phillips Electric Works, de Gaspe St., Montreal, are: Roofing and Kalamein doors, Douglass Bros., 10 Benoit St., Montreal; plumbing, Mr. Brown, Brockville; water pipe and plates, Canadian Iron Foundries Ltd., Victoria Sq., Montreal; orn. iron and steel work, A Faustin Ltd., 622 Beaudry St., Montreal and Dominion Bridge Co. Ltd.., Dominion Station, Lachine; painting and glazing, E. Gross & Co., 1 Winnin St., Montreal; glass, Hobbs Mfg. Co. Ltd., 444 St. James St., Montreal. M. J. Miller, architect, 364 Dorchester St. W. Montreal.

Dunnville, Ont.
Heating contract for factory costing $50,000 for Dominion Hammock Mfg. Co. Ltd., is awarded to Robert Fitzsimmons, 21 Rebecca St., Hamilton. W. J. Westaway Co., architects, 38 Main St. W., Hamilton.

Hamilton, Ont.
Plumbing and carpentry contracts for store and apts. costing $20,000 at corner Ottawa and Argyle Sts., are awarded to Alf. Crompton, King William St., and Dawson & Son, 254 St. Clair Ave. Hutton & Souter, architects, Bank of Hamilton Bldg.

Harris, Sask.
General contract for erection of bank bldg. for Royal Bank of Canada is awarded to Bird & Woodall, Moose Jaw, Sask.

Kitchener, Ont.
T. Winters, 103 King E., has plumbing contract for garage and show room costing $30,000 for Roy Kleinschmidt, Frederick St. C. Knechtel, architect.

Lachute Mills, Quebec.
Contracts for mill costing $100,000 for Messrs. Ayers Ltd., Lachute Mills, are: Steel, Hamilton Bridge Works Co. Ltd., Bay N., Hamilton, Ont.; roofing, Barrett Co. Ltd., 2021 St Hubert St., Montreal; electrical, Lachute Electric Lighting Co., Lachute; plumbing, McArthur & Son, Lachute.

Lamberth, Ont.
G. L. Robinson, 107 Armstrong St., Toronto has general contract for erection of branch bank for Royal Bank of Canada.

Leamington, Ont.
General contract for erection of bank for Bank of Montreal is awarded to Jno. V. Gary Construction Co. Ltd., 28 London St. W., Windsor, Little & Lawson, architects, 127 Stanley St., Montreal.

London, Ont.
Steel contract for store costing $100,000 for Cowan Hardware Co., 127 Dundas St., is awarded to London Bridge Works Ltd. Jno. M. Moore, architect, 489 Richmond St.

Montreal, Que.
Peattie Bros., City Councillors St., have plumbing and heating contracts for alterations to bank costing $15,000 for Dominion Bank of Canada. Electrical and plastering contracts are awarded to Sayers Electric Co., 47 Bleury St., and Wm. Moffatt, 1086 Clarke St.

General contract for erection of addition to bldg. costing $14 000 for Guaranteed Pure Milk Co., 875 St. Catherine St. W., is awarded to Jno. McGregor Ltd., 44 Closse St. Hutchison & Wood, architects, 86 Notre Dame St., W.

Contract for orn. iron for alterations to bldg. for cafeteria costing $75,000 for Cordners Ltd., 8 St. Monique St., is placed with Faustin Ltd., 622 Beaudry Street.

Jas. Atsalinos, 12 Lagauchetiere St. E., has general contract for erection of

(Continued on page 96)

Tenders and Proposals

Official Notices by Governments, Municipalities, Architects and Engineers

TENDER FOR DRAIN

Sealed Tenders (marked tender for Drain) will be received by the undersigned up till 2 o'clock P.M. on **Saturday, July 8th, 1922,** for the construction of the drainage work in Elma, County of Perth, known as "The Boyle Drain and South Maitland River Improvement" estimated cost of work $81,113.90. The work will be in three divisions and tenders must give the name of Sureties and be accompanied with a marked cheque for ten per cent of the estimated cost of that portion of the work.

Plans and specifications may be seen at my office, Atwood, Ontario.

The lowest or any tender not necessarily accepted.

GEO. LOCHHEAD, Clerk,
Township of Elma.
Atwood, June 19th, 1922. 25-26

TENDER FORM

Town of Thessalon, Ontario

HYDRO ELECTRIC POWER DEVELOPMENT

Sealed tenders marked and addressed to Mr. John Coulter, Town Clerk of Thessalon, will be received up to the **8th of July, 1922,** for the supply of materials, erection and construction of the following works.

Contract A.

200 H.P. Water Turbine with governor, etc. directly connected to a 175 kv. a. generator, complete with switchboard, exciter, etc. and erected in the Power House.

Contract B.

Construction of dam, head works, 48" Wood Stave pipe line, power house and tail race.

Plans and specifications may be seen at the office of the Consulting Engineers or at the office of the Town Clerk at Thessalon and a set of plans and specifications may be obtained from the Engineers for the use of the contractor upon deposit of $10.00, which will be returned when the said plans are returned.

The lowest or any tender not necessarily accepted.

JAMES, PROCTER & REDFERN, Limited,
Consulting Engineers,
36 Toronto Street,
TORONTO.
W. A. BRIDGE, Esq.,
Mayor,
JOHN O. COULTER, Esq.,
Clerk.
26

CONTRACTORS

Tenders will be received up till 5 P.M. **Saturday, July the 8th,** for the erection and completion of a six room and auditorium red brick school house, to be built at Springfield, Ontario.

Plans can be seen by applying to the Secretary or architect. The lowest or any tender not necessarily accepted.

WM. G. MURRAY,
Architect,
London, Ont.

G. W. COLLINS,
Secy. Treas.
Springfield, Ont.

26-27

RATES

20 cents per agate line (14 lines to the inch) Positions Wanted 1 cent per word per insertion. Positions Vacant 2 cents per word per insertion. Box number 10 cents extra. Advertisements for this Section must be received not later than noon on Tuesday to ensure insertion in Wednesday issue.

TENDERS

For Nurses' Home

Separate or bulk tenders for the work included in the specifications of the trades mentioned below **in connection with erection and completion** of a Nurses' Home in Riverdale Park will be received by registered post only, addressed to the undersigned, up to 12 o'clock (noon) on **Tuesday, July 4th, 1922.**

(1) Mason work. (2) Carpenter work. (3) Roofing and metal work. (4) Plumbing. (5) Steam heating. (6) Wiring and light fixtures. (7) Plastering. (8) Painting.

Plans and specifications may be seen and forms of tender and all information obtained at the office of the City Architect. Envelopes containing tenders must be plainly marked on the outside as to contents. The usual conditions relating to tendering as prescribed by City Bylaws must be strictly complied with, or tenders may not be entertained. Tenderers shall submit with tender the names of two personal sureties or guarantee company approved by the City Treasurer. The lowest or any tender not necessarily accepted.

C. A. MAGUIRE (Mayor,)
Chairman, Board of Control.
26

DEPARTMENT OF ROADS

TENDERS

Montreal-Ottawa Highway via Hull

Tenders made on forms supplied by the Department of Roads and placed under envelopes bearing the words "Tender for Montreal-Ottawa Highway," followed by the name of the interested municipality, shall be received at the office of the Minister of Roads, in the City of Quebec, Government Building, up to one o'clock of the afternoon (daylight saving time.) on **Tuesday the eleventh (11) of July 1922,** for the construction of a macadamized road in the Monte Cazeau in the parish of St. Eustache and on the Petit **Brule road in the parishes of St. Augustin and** of Ste. Scholastique and for the construction of **a gravelled road in the Monte Paiement in the parishes of Ste. Scholastique and of St. Hermas** and in the St. Hermas and East Settlement by-**roads in the parish of St. Jerusalem.**

The Government of the Province of Quebec **does not bind itself to accept any of the tenders.**

The present notice completes and corrects the notice given on the 16th of June 1922.

J. L. BOULANGER,
Deputy Minister.
Quebec, June 22nd, 1922. 26

SEALED TENDERS

Marked "Tenders for the excavation of the Shaw's Creek Drain" will be received by me at Cumberland, Ont. up to 9 o'clock a.m. and at Town Hall, Leonard, Ont. up to 2 o'clock p.m. on **Monday the 3rd day of July, 1922.**

Estimate quantities.
31,419 cubic yards Earth Excavation.
19 cubic yards Rock Excavation.

The Municipal Council reserves the right to itself to accept or reject any or all tenders.

A cash deposit or accepted Bank cheque equal to 10% of the tendered price must accompany each tender otherwise the tender will not be considered.

Drawings, specifications, forms of tender may be examined at the office of W. H. Magwood, Civil Engineer, Cornwall, Ont.

Dated at Cumberland, the 20th of June, 1922.

W. W. DUNNING,
Township Clerk.
26-27

TOWNSHIP OF YORK

TENDERS

PAVEMENTS and GRADING

Sealed Tenders, plainly marked as to contents, will be received by the undersigned up to 12 **o'clock noon of Monday, July 3rd, 1922, for the construction of Bituminous Macadam Pavements on Dunvegan Road and Forest Hill Road, also an Asphalt Pavement on Normanna Avenue and** the grading of Bicknell Avenue.

Plans and specifications may be seen at the office of the undersigned, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Township Engineer.

Frank Barber and Associates Limited,
Consulting Engineers,
40 Jarvis Street,
Toronto.
Toronto, June 19th, 1922. 25-26

CONTRACTORS

Tenders will be received up until noon, **Tuesday, July 4th,** for the several trades required for the erection of Swimming Pool and Gymnasium for Alma Ladies College. Plans and all particulars can be received at the office of the undersigned.

The lowest or any tender not necessarily accepted.

DARRACH & FINDLAY, Architects,
430 Talbot St., St. Thomas,
Ontario.
June 20th, 1922. 26

Notice to Contractors

Engine for hire, Sawyer Massey, large type high pressure boiler, 90 h.p. belt, rear mount, suitable for crusher work. Box 931, Contract Record, Toronto. 26

The Toronto Transportation Commission

TENDERS

Sealed tenders will be received for the construction of Eglinton Car House, Eglinton Avenue and Yonge Street, Toronto, consisting of three reinforced concrete car houses, and a brick office building, and including all plumbing, heating, electric wiring, rolling steel doors, automatic sprinklers and all other work necessary for the completion of the buildings.

All tenders are to be endorsed **"Tender for Eglinton Car House" and are to be addressed** to the Chairman of the Toronto Transportation Commission, and are to cover all the work contemplated and must be delivered to the Offices of the Commission, Public Utilities Building, Yonge and Front Streets, not later than 12 noon on **Monday, July 10, 1922.**

Each tender must be on the Commission's form of tender and must be accompanied by an accepted bank cheque payable to the Toronto Transportation Commission for two and one-half per cent. (2½%) of the amount of the tender.

Plans and specifications, Form of Tender, and instructions to bidders may be obtained on application to the Commission's Building's Department, third floor, Public Utilities Building, Toronto.

The lowest or any tender not necessarily accepted.

H. H. COUZENS,
General Manager,
Toronto Transportation Commission.
26

Township of York

TENDERS

For Concrete Sidewalks

Sealed tenders, plainly marked as to contents, will be received by the undersigned up to 12 o'clock Noon of **Saturday, July 8th, 1922,** for the construction of Concrete Sidewalks on Alameda Avenue, Avon Avenue, Brunswick Avenue, Dentonia Park Avenue, Eastdale Avenue, Humewood Drive, Gordon Avenue, Keene Street, Kendal Avenue, Lumsden Avenue, Meagher Avenue, Mould Avenue, Orla Avenue, Pritchard Avenue, Runnymede Road, Strathearn Blvd., and Walnut Avenue.

Plans and Specifications may be seen at the office of the undersigned, 40 Jarvis Street, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Township Engineer.
FRANK BARBER AND ASSOCIATES Limited,
Consulting Engineers,
40 Jarvis St.,
Toronto.
Toronto, June 26th, 1922. 26-27

Notice to Contractors

Tenders for Concrete Pavement

Tenders sealed and marked as to contents, will be received by the undersigned up to **Wednesday, June 28th**, for the construction of 9,920 sq. yds., of Reinforced Concrete Pavement on King Street in the Village of Hensall.

Plans and specifications may be seen, and information to bidders, and form of tender secured **at the office of the undersigned, or at the office of** T. R. Patterson, Engineer, Goderich, Ont.

The lowest or any tender not necessarily accepted.

A. MURDOCK,
Clerk of the Village of Hensall.
Hensall, June 14th, 1922. 25-26

Tenders Wanted

BOARD OF EDUCATION

Sealed tenders, addressed to the Business Administrator & Secretary-Treasurer, Board of Education, Administration Building, 155 College St., endorsed with the word "Tender" and also with the name of the school building and trade or article to which it relates, will be received until

MONDAY, JULY 3, 1922

—for—

(1) **Masonry, Structural Steel, Ornamental Iron, Steel Sash, Carpentry, Roofing & Tinsmithing, Plastering, Painting & Glazing, Terrazzo & Marble Work, Plumbing, Heating & Ventilating, Heat Regulation, Electric Wiring, Local Phones for KITCHENER SCHOOL.**
(2) **Masonry, Structural Steel, Ornamental Iron, Steel Sash, Carpentry, Roofing & Tinsmithing, Plastering, Painting & Glazing, Plumbing, Heating & Ventilating, Electric Wiring for MALVERN COLLEGIATE.**
(3) **Fibre Mastic Floors for DUFFERIN SCHOOL.**
(4) **Roofing & Tinsmithing for ANNETTE ST. SCHOOL.**
(5) **Carpentry for FERN AVE. SCHOOL.**

Specifications and conditions of tendering may be seen and all information obtained at the office of the Architect of the Board, 155 College St., Telephone College 8200.

Tenders must be in the office of the Secretarial Department at the Administration Building, 155 College St., **not later than 12 o'clock noon, on the day named,** after which no tender will be received.

The lowest or any tender will not necessarily be accepted.

W. W. PEARSE,
Business Administrator & Secretary Treasurer.

E. CHAS. BEER,
Chairman of Property Committee. 26

CIVIL AND MECHANICAL ENGINEER with extensive Engineering, Contracting and Financial experience desires good permanent connection. Would consider interest in business later. Interview requested. Box No. 950, Contract Record, Toronto. 26-27

Position Vacant. Structural Designer in Steel and Reinforced Concrete. Must be able to take initiative. State fully training and experience. Address Box No. 951, Contract Record, Toronto. 26-27

TENDERS

For the Construction of the Renfrew Collegiate Institute and Vocational School, Renfrew, Ont.

General Tenders wanted, including Excavation, Masonry, Brick Work, Reinforced Concrete Work, Hollow Tile, Structural Steel, Stone Work, Carpentry, Joiner Work, Steel Casements, Ornamental Iron, Metal Lath and Plastering, **Painting and Glazing, Roofing and Sheet Metal Work, Electrical conduit and Wiring, Plumbing, Heating and Ventilating.**

Tenders to be in the hands of Mr. S. T. Chown, Chairman, Renfrew Board of Education, Renfrew, by **8:00 P.M. July 18th, 1922.**

Tenders will only be acceptable on special **forms, and in sealed envelopes, which will be** furnished for this purpose by the Architects.

A deposit of a marked cheque of 2½% of the amount of the contract or a Bid Bond is required with each Tender, and when the contract is executed a bond of 50% of the contract will be required.

A deposit of $25.00 is required by the Architects to procure plans for figuring. In the event of the plans not being returned on the date specified, the said deposit of $25.00 will be forfeited.

Plans, Specifications, Tender Forms, and information may be had at the office of the Architects S. B. Coon & Son, No. 4 St. Thomas **Street, Toronto, and S. T. Chown, Chairman,** Renfrew Board of Education.

Toronto, June 25th, 1922. 26

For Sale

CAST IRON PIPE

Eight 12 foot lengths 48 inch—Class A, Bell and Spigot, new, shipping point near Montreal. Box 941 Contract Record, Toronto. 25

Concrete Mixer for Sale

London Concrete Mixer No. 8 on trucks with Novo gasoline engine housed, automatic loading hopper, and water tank. Capacity eight cubic feet. Price $700.00.

Charles F. Till,
19 Grassmere Road,
Toronto. 26

Yellow Fire Hydrants in Philadelphia

After much study Philadelphia is making a trial of yellow paint on its fire hydrants in place of the dark green or brown color heretofore used. Yellow was adopted after consultation by the Water Bureau with representatives of the fire and police departments, automobilists teamsters and others. It was concluded that yellow would be satisfactory because it can be seen easily at night and in fog or rainy weather. It was also concluded that yellow would be sufficiently conspicuous to be seen by drivers of automobiles and motor trucks, thus reducing the number of breaks in fire hydrants by these machines, there being an average of a hydrant a day broken by motor driven and other vehicles.

stores and residences costing $15,000. Co. Ltd., Abell St., Toronto.

Port Colborne, Ont.

Masonry and steel contracts for plant costing $100,000 for International Nickle Co. are awarded to Stuart & Sinclair, 17 Jackson St. E., Hamilton, and Hamilton Bridge Works Co. Ltd., Bay St. N. Hamilton.

Port Dover, Ont.

General contract for erection of branch bank costing $10,000 for Royal Bank of Canada is awarded to G. L. Robinson, 107 Armstrong St., Toronto.

Red Deer, Alta.

General contract for erection of warehouse and oil tanks costing $10,000 for British American Oil Co., is awarded to Hugh Clarke.

Richmond Hill, Ont.

W. H. Graham, Richmond Hill, has general contract for erection of garage costing $15,000 for W. G. Baldock Ltd., Richmond Hill. Addditional contracts are: Masonry and plastering, L. Doner, Richmond Hill; plumbing, Richmond Hill Plumbing Co.; roofing, Duthie & Son, 650 Dufferin St., Toronto; steel, Hepburn & Disher, 71 Van Horne St., Toronto.

Saskatoon, Sask.

General contract for erection of office bldg. costing $15,000 for Quaker Oats Co,. is awarded to Joseph Bigelow, c/o owner.

Sudbury, Ont

General contract for erection of ware-Brickwork contract is placed with J. Gody, 2730 Drolet St.

General contract for erection of store and 5 flats costing $21,000 for Mr. Burland is placed with Z. Heroux, 1641 St. Denis St. Electrical and plastering contracts are awarded to M. Martel, and J. Brasseau, c/o contractor.

Z. Heroux, 1641 St. Denis St., has general contract for erection of 2 stores and 4 flats costing $23,000 at corner Oxford Ave., and Sherbrooke St.

Niagara Falls, Ont.... ... .

General contract for erection of service station for Imperial Oil Ltd., is awarded to Robertson Construction Co., Bampfield Block.

Ottawa, Ont.

Steel and plumbing and heating contracts for factory costing $30,000 for F. H. Plant Ltd., 107 Murray St., are awarded to Dominion Bridge Co. Ltd., Carleton Chambers, and Gauthier & Co., Dalhousie St.

Plumbing contract for store and apts. costing $20,000 for D. G. Cowan, Bank and Cameron Sts., is awarded to Gervin & Hodins, Bank and Sunnyside. Millson & Burgess, architects, 209 Sparks St.

Contract for steel sash continuous sash and operators for Beach Motors Bldg. is placed with The A. B. Ormsby house costing $10,000 for Revillion Freres, 134 McGill St., Montreal, is awarded to Fred Levesque. P. J. O'Gorman, architect, 105 Stafford Block.

Three Rivers, Que.

Contract for piling for pulp mill costing $4.000,000 for Three Rivers Pulp & Paper Co. Ltd., is awarded to Raymond Concrete Pile Co. Ltd., 10 Cathcart St., Montreal. J. J. O'Sullivan, Chief Engr.

Toronto, Ont.

F. J. Blakeman, 250 Glenview Ave., has general contract for erection of store and office bldg., costing $15,000 for T. S. Beasley, 2501 Yonge St.

Fred Holmes & Sons Ltd., 123 Bay St., have general contract for alterations to Shea's Hippodrome for installing organ and decorating costing $40,000.

General contract for erection of addition to bldg. to cost $150,000 for Farmers Dairy Co. Ltd., Walmer Rd., is awarded to Jackson-Lewis Co. Ltd., Ryrie Bldg. Harkness, Loudon & Hertzberg, architects, Confederation Life Bldg.

Electrical and heating contracts for 2 stores and apts. costing $30,000 for Roberts Bros., 241 Dovercourt Rd., are awarded to Geo. Armstrong, 1391 Ossington Ave., and W. Schulkins, 932 College St.

General contract for erection of addition to tannery costing $15,000 for Wickett & Craig, Eastern Ave., is awarded to Adam Switzer, 216 Withrow Ave. Jas. Thompson, architect, 59 Yonge St.

H. Robertson & Sons Ltd., general contractors for erection of Crean Bldg., awarded contract for steel sash and glazing to the A. B. Ormsby Co. Ltd., 48 Abell St.

Vancouver, B. C.

General contract for erection of service station for Imperial Oil Ltd., is awarded to Dominion Construction Co., 509 Richards St.

Winnipeg, Man.

Plumbing and heating contracts for alterations, etc., to bldg. costing $25,000 for G. H. Gregg & Co. Ltd., Albert St., are awarded to Jno. Plaxton & Co. Ltd., 244 Main St. Frank R. Evans, architect, Confederation Life Bldg.

Contracts for addition to Grain Exchange for Traders Bldg. Ass'n. Ltd., are: Roofing, and sheet metal, Western steel Products Ltd., St. Boniface; plumbing and heating, Cotter Bros. Ltd., Fort St. and St. Marys Ave.; structural steel, Dominion Bridge Co. Ltd., Jordon & over, architects, C.P.R. Bldg.

Plumbing and heating contracts for alterations to bldg. costing $11,000 for The Hemphill Trade Schools Ltd., are awarded to Jno. Plaxton Co. Ltd., 244 Main St. Frank R. Evans, architect, Confederation Life Bldg.

Thomas Sharpe, 802 Lindsay Bldg., has general contract for erection of office bldg. for Physicans and Dentists of Winnipeg. Dr. C. P. Panning, Chrm., 909 Boyd Bldg. J. D. Atcheson & Co., architects 914 Boyd Bldg.

Residences

Hamilton, Ont.

Geo. T. Evans, architect, Clyde Block, is preparing plans for residence to cost $20,000.

Montreal, Que.

Hadley & Everley, 453 Bleury St., are building 2 residences at cost of $18,000.

J. A. Girard, 921 Mt. Royal St. E., is erecting a residence costing $10,000.

Ottawa, Ont.

W. G. Lanthier, 177 Rochester St., contemplates erection of duplex residence.

Millson & Burgess, architects, 209 Sparks St., are preparing plans for residence to cost $10,000 for T. H. Brownlee, c/o architects.

Outremont, Que.

E. Alarie, 1983 Clarks St., will erect a residence (3 flats) at cost of $12,000.

Quebec, Que.

Residence costing $20,000 will be erected by J. B. Letellier, 7 Couillard St. Heliodore Laberge, architect, 412 St. John St.

Alex. Fraser, 16 Aberdeen St., and J. A. Buteau, 10 Aberdeen St., will erect a duplex residence costing $15,000. Heliodore Laberge, architect, 412 .St John St.

Toronto, Ont.

Merrill System, Union Trust Bldg., will receive tenders for sub trades until July 6th for apt. house to cost $70,000 at Jarvis and Earle Sts. Plans at 3 Earl St. W. G. Hunt, architect, Confederation Life Bldg.

Mayor C. A. Maguire will receive tenders until July 4th for masonry, carpentry, roofing sheet metal, plumbing, heating, wiring, electric fixtures, plastering and painting, for Nurses' Home. Plans with City Architect, City Hall.

Plans are prepared for residence to cost $15,000 for J. G. McKee, Pearson Hotel, Centre Island.

Westmount, Que.

J. B. Fellows, 60 Nelson Ave., will erect 2 residences at cost of $30,000.

CONTRACTS AWARDED

Hamilton, Ont.

Additional contracts for apt. house costing $25,000 for R. S. Mason, 41 Hilda Ave., are: Brick and masonry, Jno. Tope, 218 Charlton W.; carpentry, S. Howard, 231 Mary St.; plumbing and heating, Herbert Barnes, 310 Ottawa St. Block.

Kitchener, Ont.

Knell & Co., 45 King W., have plumbing contract for rectory costing $50,000 for St. Marys Congregation. Chas. Knechtel, architect 31 Courtland Ave.

G. Ruppel, 31 King W., has heating and plumbing contracts for residence and milk dispensary costing $10,000 for A. H. Behling, Glasgow St. W. C. Cowan, architect. 430 King E.

London, Ont.

John Putherbough, 1006 Wellington St., is awarded general contract for erection of residence costing $15,000 for Dr. E. L. Hodgins, 312 Oxford St. Watt & Blackwell, architects, Bank of Toronto Bldg.

Montreal, Que.

Vezina & Dugal, 1244 Dorion St., have general contract for erection of residence costing $10,000 for J. A. Heroux, 1297 St. Denis St.

Millwork contract for 18 residences and 40 garages costing $200,000 for Senneville Development Co., 350 Cote des Neiges Rd., is awarded to Wm. Rutherford & Sons, 425 Atwater Ave.

General contract for erection of residence costing $10,000 for J. Major, 1708 de L'Eglise St., is awarded to C. Barbeau, 1605 de L'Eglise St.

D. F. Sheehy, 9 St. Cecile St., has general contract for repairs to residence costing $10,000 for Catholic High School 55 Durocher St.

Additional contracts for apt. house costing $80,000 for Dr. G. A. Belanger,

(Continued on page 98)

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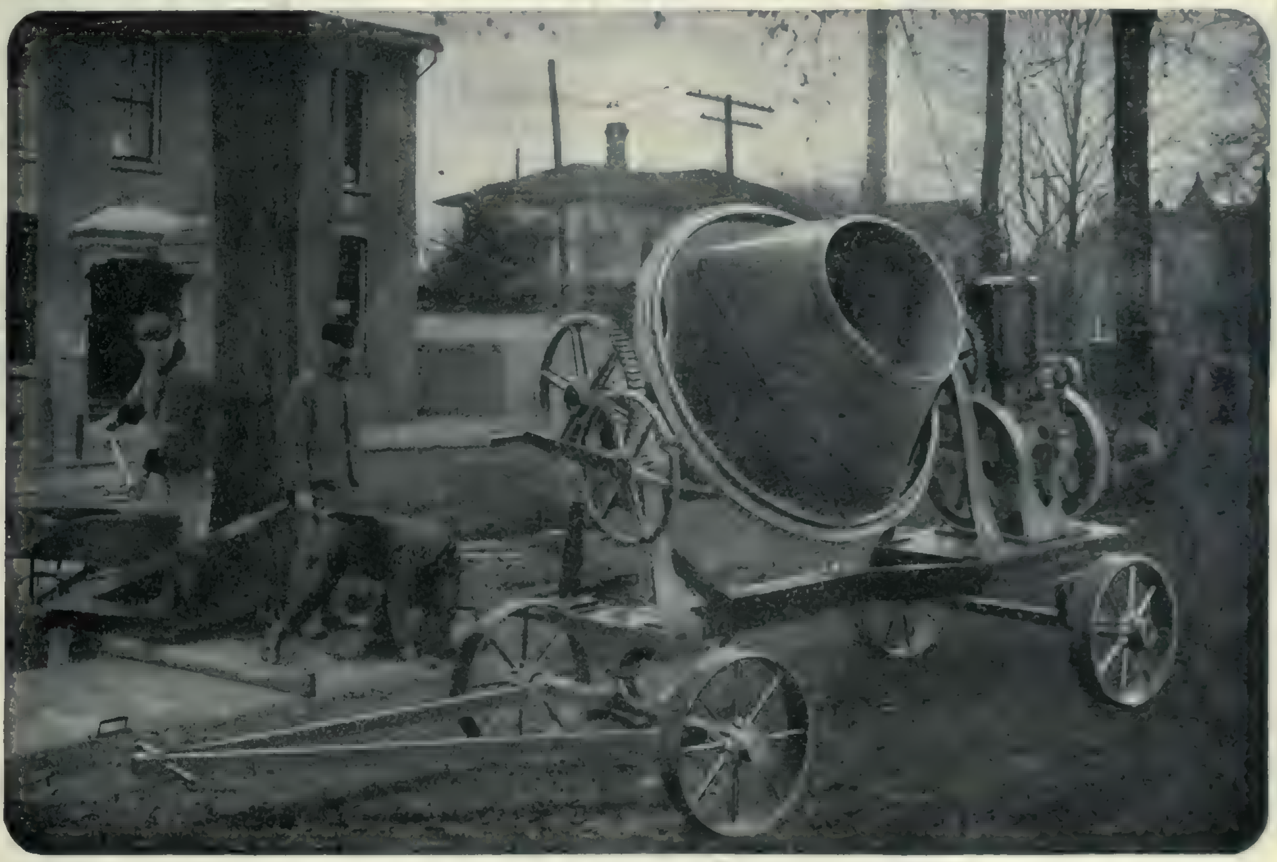

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21 St. Famille St., are: Roofing, J. E. Menard, c/o general contractor, Louis Berna, 1316 Bernard Ave.; plumbing & heating, J. Grimard, 1271 de la Roche; tiling, P. Capra, c/o general contractor.

Ottawa, Ont.

McArthur Bros., Arlington Ave., have masonry Contract for residence costing $22,000 for N. Smith, c/o Richards & Abra, architects, 126 Sparks St.

Outremont, Que.

General contract for erection of cottage costing $14,000 for Victor Fortier, 1213 St. Viateur St., is awarded to A. Mongeau, 318 Lepailleur St. Perreault & Gadbois, architects, 2100 Park Ave.

Henderson & Fils, 260a St. Joseph St., Lachine, have general contract for erection of cottage costing $20,000.

Electrical and plastering contracts for residence costing $25,000 for A. Fortier, 23 Mount Royal Ave., are awarded to A. L. Allard, 162 Mount Royal Ave., and A. Fortin, 637 de Lanaudiere St. D. E. Painchaud, 218 Chatham St.

Rockcliffe, Ont.

Masonry and carpentry contracts for residence costing $15,000 for A. S. Sherwood, c/o J. P. MacLaren, architect, 104 Sparks St., Ottawa, are awarded to Jas. Patterson, 837 Sommerset St. W., and J. A. Mackie, Arlington Ave., Ottawa.

Toronto, Ont.

W. A. Charlton, 130 Hazleton Ave., has general contract for erection of residence costing $20,000 for H. Mendelson, 54 Foxbar Rd. B. Brown, architect, Manning Chambers.

J. A. Harvey, 2 Gould St., has general contract for erection of a residence costing $18,000 for John W. Hopkins, 228 Rusholme Rd.

Duncan McDonald, 281 St. Clarens Ave., has general contract for erection of residence costing $15,000 on Graham Rd.

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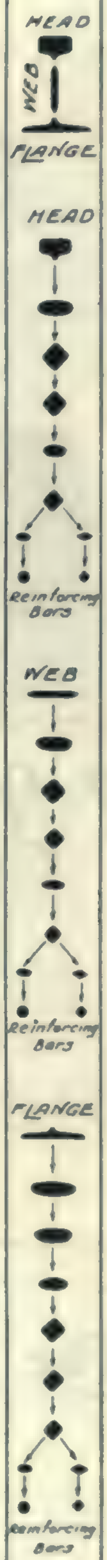

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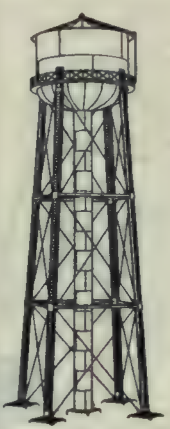

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Current Prices of Building and Engineering Materials

		Toronto	Montreal.	Winnipeg.	Vancouver
CEMENT (Delivered on job):—					
Retail lots, including bags	per bbl	$4.60	$4.40	4.80	$3.70
Car lots, including bags	per bbl.	3.90	3.68	$4.16	3.35
Refund on bags	each	20	.20	.20	
LIME (Delivered on job):—					
Lump, in retail lots	per ton	14.30	14.00	.58 bu.	2.70 bbl.
Lump, in car lots	per ton	12.70**	11.00	13.80 ton*	2.60 bbl
Hydrated, in retail lots	per ton.	19.25	26.00	.60 bag*	30.00
Hydrated, in car lots	per ton.	18.00	21.00	.54 bag*†	25.00
BRICK and TILE (Delivered on job):—					
Common face brick	per M.	24.00	16.00*	19.00	30.00
No. 1 dry pressed brick	per M.	29.00	30.00	40.00	70.00
No. 2 dry pressed brick	per M.	28.00	25.00	38.00	
Enamelled brick	per M.	125	up to 230.00	185.00	150.00
Wire cut brick, for foundation work	per M.	20.00	19.00		50.00
Sand lime brick	per M.	17.00			
Hollow building tile	per M.		8¼-29c.per ft.	13-24c per ft.	105-240.00
Paving brick, imported	per M.	on appl.	100.00	55.00	60.00
Fire brick	per M.	65-95	60-75	85-100	80.00
Fire clay	per ton	13-20	15-16.00	35.00**	22.00
STONE, SAND and GRAVEL (f.o.b. cars on siding):—					
Crushed stone, 2 in.	per ton	2.05	1.90	2.45 yd.*	$2.00 yd
Crushed stone, 1 in. and under	per ton	2.31	2.00	2.75 "	" "
Crusher run	per ton	2.20½		3.00 "	" "
Rubble stone	per ton	2.45	1.80	15.00 cord	" "
Gravel, 2 in. screened	per ton	2.05		2.45 yd.	" "
Gravel, 1 in. screened	per ton	2.31	1.50	2.75 "	" "
Sand, screened	per ton	1.42½	1.25	1.90 "	" "
Pit run	per ton	1.52¾	1.25	1.90 "	" "
STEEL and IRON (f.o.b. warehouse):—					
Mild steel bars, ¼ in. and heavier	per 100 lbs.	2.90 base	2.90 base	5.00	$4.00
Bands 3/16 in. and lighter	per 100 lbs.	3.40 "	3.25 "	5.50 base	
Hoops	per 100 lbs.	4.00 "	4.25 "		
Twisted and deformed bars	per 100 lbs.	2.90 base	2.90 base	5.25	4.00
Angles, channels and tees under 3 in.	per 100 lbs	3.00 "	3.75 "	6.00	5.00
Structural shapes	per 100 lbs.	3.00 net	3.75 "	5.75	5.00
Plates—¼ in. and heavier	per 100 lbs.	3.00 base	3.25 "	5.65	6.25
Plates—3/16 in.	per 100 lbs.	3.40 "	3.60 "	5.70	6.50
Plates—10 gauge	per 100 lbs.	4.00 "	3.90 "	6.00	6.50
Black sheets—28 gauge	per 100 lbs.	4.80	4.50	6.05	8.35
Galvanized sheets—28 gauge	per 100 lbs.	5.85	6.00	7.50	9.35
Galvanized Corrugated sheets—28 gauge	**per 100 ft.**	6.00	6.50	8.00	8.25-8.50
Rivets	per 100 lbs.	5.50 base	6.50 base	7.00 base	
Cast iron pipe	per ton.	60.00	50.00		
VITRIFIED CLAY PRODUCTS (Delivered on job):—					
Sewer pipe, 4 in.	per ft.	.40	.30	.35	.28
Sewer pipe, 6 in.	per ft.	.60	.45	.45	.42
Sewer Pipe 8 in.	**per ft.**	.80	.70	.60	.55
Sewer Pipe 9 in.	**per ft.**	1.00	.85	.70	.60
Sewer Pipe 10 in.	**per ft.**	1.20	1.05	.80	.70
Sewer Pipe 12 in.	**per ft.**	1.50	1.35	1.00	.85
Sewer pipe, 15 in.	per ft	2.25	1.80	1.34	.95
Sewer pipe, 18 in.	per ft.	3.00	2.50	2.45	1.50
Sewer pipe, 21 in.	per ft.	4.00	3.00		1.90
Sewer pipe, 24 in.	per ft.	6.00	4.50	2.75	2.10
Tile wall coping, 8 or 9 in.	per ft.	.60	.50		.50
Tile wall coping, 12 or 13 in.	per ft.	.90	.75		.60
Flue lining, 8½ x 8½ in.	per ft.	.70	.60	.55	.40
Flue lining, 8½ x 13 in.	per ft	1.00	.90	.75	.75
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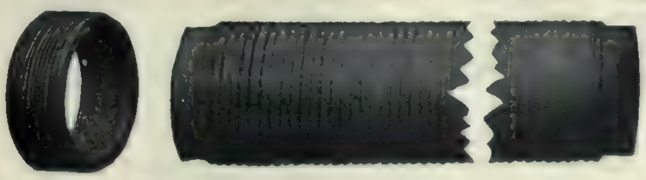

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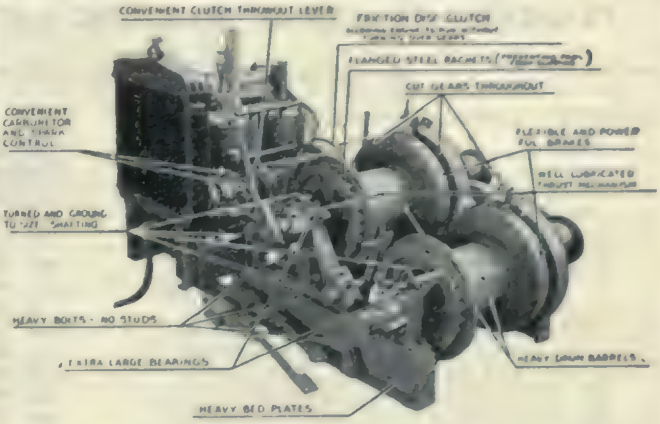
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1 —10" Pump direct connected to Steam Engine.
1 —10" Pump belt driven.
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Flooring, 1 x 3 and 4 in., clear, F. G. fir	per M.	70.00	65.00	50.40	30.00
Flooring, No. 1 pine	per M.	70.00	80.00	64.80	
Flooring, No. 1 Spruce	per M.	45.00	40.00	39.60	
Flooring, birch and maple, 13/16 in. clear	per M.	130.00	100.00	166.50	200.00
Flooring, plain red oak, ⅞ in. clear	per M.	140.00	125.00	138.60	265.00
V joint, 1 x 3 and 4 in., Nos. 1 and 2, clear, fir	per M.	70.00	60.00	50.40	30.00
V joint, No. 1 pine	per M.	70.00	85.00	63.00	
Pine, 1 x 4 to 12 in., common rough	per M.	43-58	45.00	76.50	
Pine, 2 x 4 to 12 in., common rough	per M.	50/55	70.00	34.20	
Hemlock, 2 x 4 to 12 in.	per M.	38-40.00	40.00	34.20	11.50-18.75
Fir, 1 x 4 to 12 in. No. 1 common, D 1 S	per M.	40-50.00	50.00	34.20	11.00-13.50
Spruce, 1 and 2 x 4 to 12 in.	per M.	43/58	45-35	34.20	
Timbers, fir, 10 x 10 in. and up	per M.	60.00	58.00	38.60	base 17.- 22.00
Lath, No. 1 white pine	per M.	14.00	12.00	12.15	
Lath, M. R. spruce	per M.	10.00	8.50	10.80	7.00
Shingles, XXX B.C. cedar	per M.	7.00	5.00	5.35	3.40
XX B.C. cedar	per M.	5.50	4.00	4.05	1.90
N.B. extras	per M.	7.00	6.50		
N.B. clears	per M.	6.50	5.50		
Pine casing	per M.	1 ct. per in.	95.00	108.00	
Fir casing	per M.	1 ct. per in.	100.00	108.00	55.00
PAINTS, OILS, COLOURS (delivered):—					
White lead ground in oil, less than ton lots	per cwt.	13.55	13.10	14.35	15.80
Red lead, dry, small lots	per cwt.	17.00	9.55	20.00	22.00
Putty in bulk	per cwt.	6.70	4.75	5.50	9.25
Steel sash putty in bulk	per cwt.	7.20	6.00	9.00	7.75
Boiled linseed oil, in bbls.	per gal.	1.08	1.06	1.23	1.28
Raw linseed oil, in bbls.	per gal.	1.05	1.04	1.20	1.25
Turpentine, in bbls.	per gal.	1.45	1.40	1.55	1.60
Mortar Color, maroon, in bbls.	per lb.	.02¼		.05¼	6.45 per cwt
Mortar Color, black, in bbls.	per lb.	.06		.06¼	.45
PLASTER (Delivered):—					
Hard wall plaster, sanded	per ton	13.50	15.00	25.00	30.00
Plaster of paris, in bbl. lots	per bbl.	6.00	5.35	1.60 bag*	7.50
Plasterers' hair	per bag	2.50	7½ cts. per lb.	1.00 bu	1.50
LABOR:—					
Bricklayers	per hr.	1.00	.80-.90	1.15	1.06¼
Structural Iron Workers	per hr.	.85	.50-.75	1.25	1.00
Plasterers	per hr.	1.00	.80	1.05	1.06¼
Hoisting Engineers	per hr.	.70-.80	.50	.90-1.10	1.00
Plumbers	per hr.	.90	.60-.75	1.00	.90
Carpenters	per hr.	.80	.65	.90	.81¼
Painters	per hr.	.75	.55-.65	.80	.81¼
Electrical Workers	per hr.	.87½	.65	.70- .90	1.00
Roofers	per hr.	.65	.65		.90
Laborers	per hr.	.40-.50	.30	47½-.55	.50-.56¼
Sheet Metal Workers					.90

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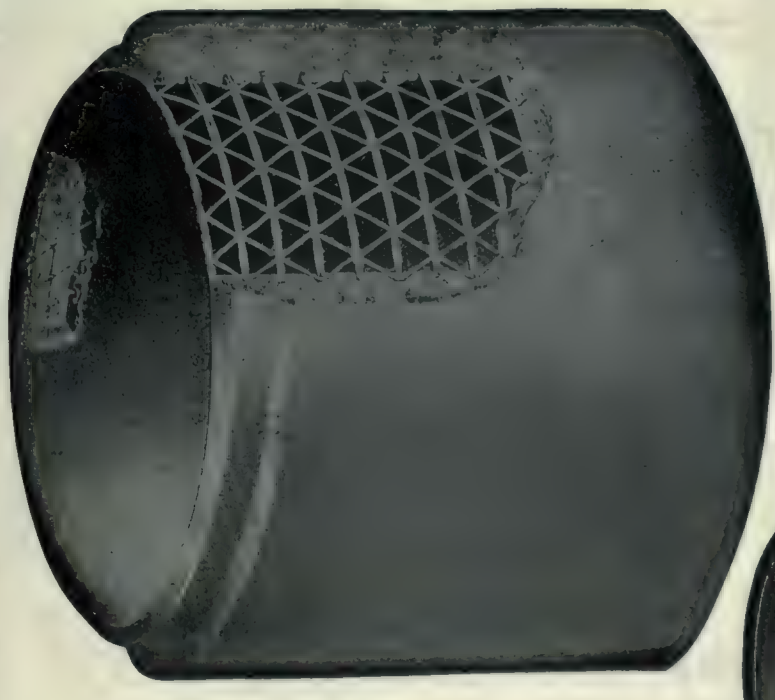

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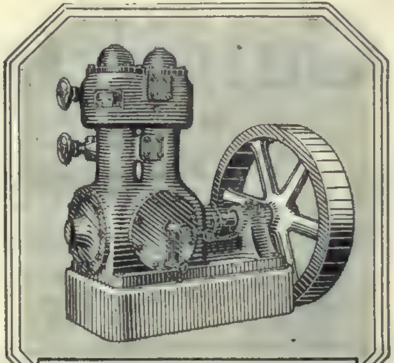

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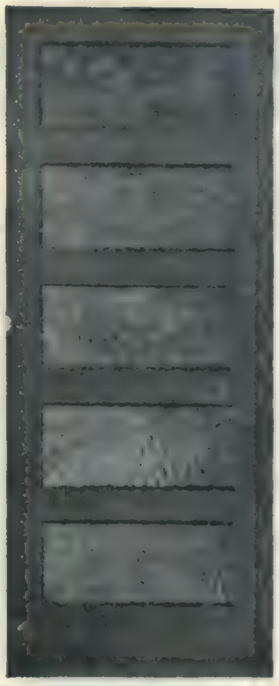

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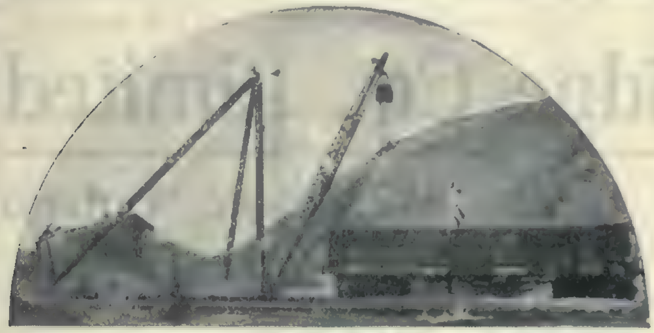

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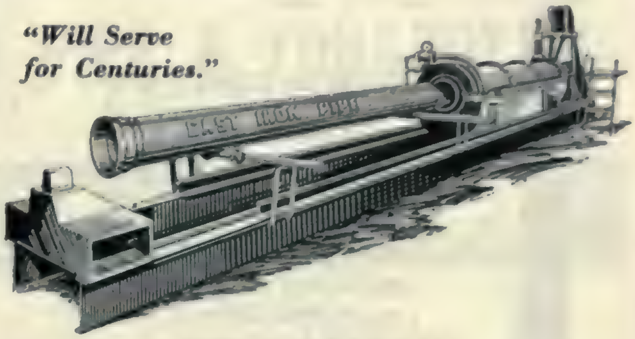

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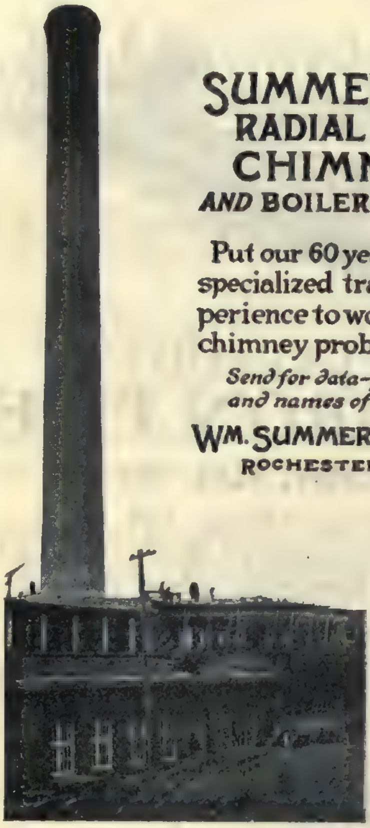

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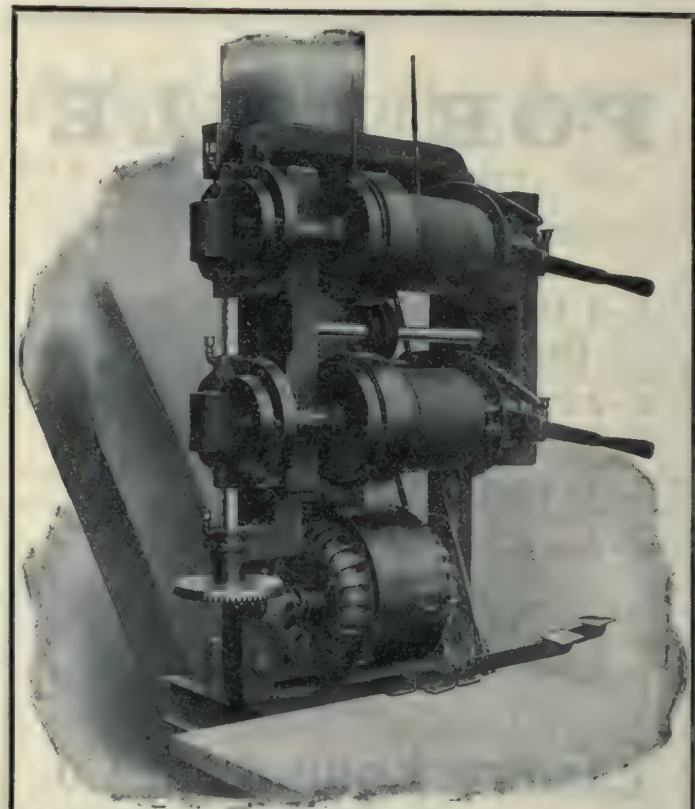

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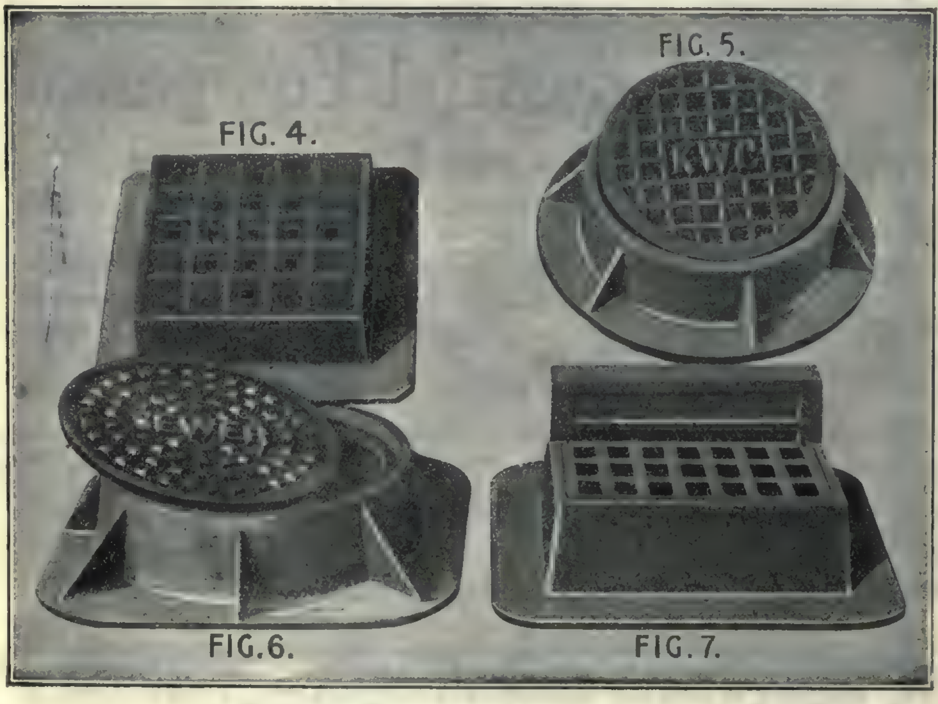

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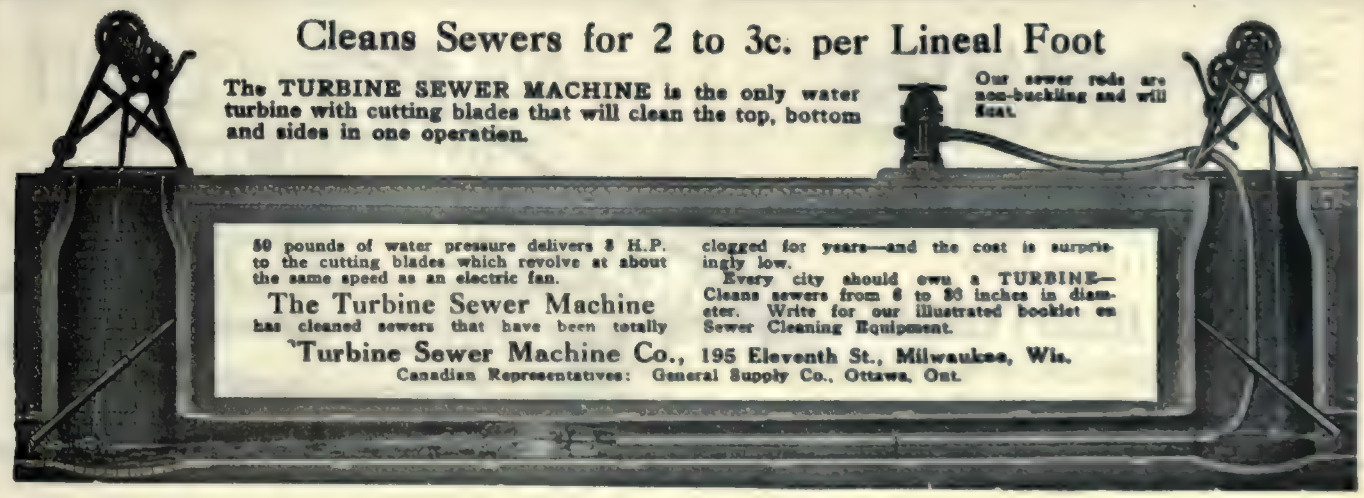

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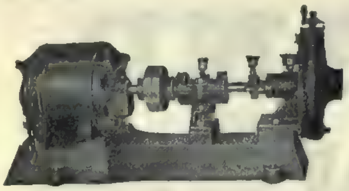

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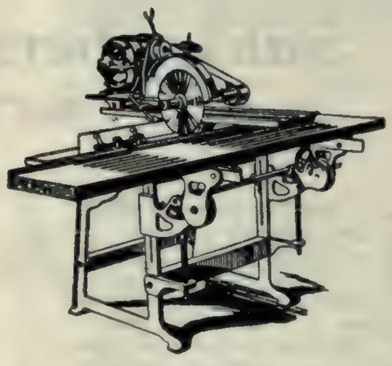

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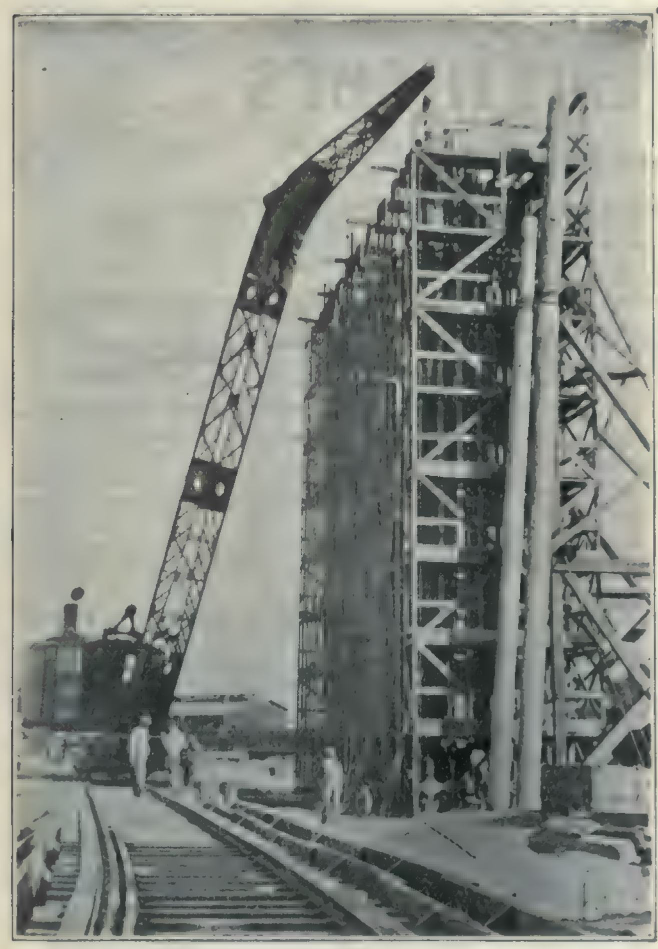

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